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Mandatory Versus Voluntary Disclosures: The Cases of Financial and Real Externalities

Ronald A. Dye
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ABSTRACT: This paper compares the disclosures firms would seek to make voluntarily with "optimal" mandated disclosures in a single period, multi-firm model, in which there are covariances between firms' cash flows. This comparison is important because, in those circumstances in which the two types of disclosure coincide, it is possible to economize on the process of setting mandatory disclosures. The principal factors which contribute to the existence or absence of a correspondence between mandatory and voluntary disclosures are (1) the nature of the externality associated with a firm's disclosure, (2) the relation between the risk preferences of the shareholders of the firms making the disclosures and outside investors, (3) how much relative weight is placed on existing shareholders and outside investors' preferences in the social welfare function determining the optimal mandatory disclosure policy, and (4) the covariance structure between firms' cash flows.

THIS paper compares the disclosure policies that firms select voluntarily with the policies an accounting standards board or other regulatory body would mandate to maximize social welfare. This comparison is important because of the considerable resources devoted to developing accounting standards and related disclosure requirements. When an accounting standards

I wish to thank Mike Fishman, Steve Hansen, Bill Kinney, Bob Magee, and seminar participants at the University of Minnesota for helpful comments on a previous draft, and the Accounting Research Center at Northwestern University for financial support. I especially want to thank Jerry Feltham (a referee) and an anonymous referee. They contributed significantly by extending some results and, in several instances, proposing (and proving) important additional results.

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board merely succeeds in mandating the disclosures which firms would adopt voluntarily, the resources used in setting the standards are wasted. By identifying a variety of situations in which mandatory and voluntary disclosures coincide, the paper provides some evidence for Beaver's (1977) proposal that promulgators of accounting standards should be obliged to provide explicit cost-benefit analyses to support the expansion of disclosure regulations.

The claim that voluntary and mandatory disclosure requirements should be presumed to be the same, unless otherwise demonstrated, stands in contrast to much of the prevailing scholarly literature on the subject. Proponents of additional mandatory disclosures argue that information about firms' financial conditions constitutes a public good which will be under-provided without regulation. They also assert that firms will tend to suppress the disclosure of unfavorable information.[1] Opponents of regulation counter by arguing that managers have incentives to disclose information about the firms they run to differentiate themselves from more poorly run enterprises. This incentive, as well as the incentive of investors to obtain trading profits through costly search, are considered to provide sufficient motives for voluntary information production and disclosure so as to ensure a properly functioning securities' market.[2]

This paper does not directly contradict either of these views. The point made is that, in presenting these externality-based arguments for or against additional disclosures, one must differentiate between the various kinds of externalities that can arise. We consider two alternative types of externalities here, "real" and "financial." A disclosure by one firm is said to create a real externality for other firms if the disclosure alters those firms' cash flows. For example, the disclosure of a firm's trade secrets generates positive real externalities for its competitors. In contrast, a disclosure by one firm generates only financial externalities on other firms if the disclosure has the potential of altering the equilibrium prices of those firms without altering the actual distributions of their cash flows. Financial externalities arise when one firm's disclosures affect only investors' *perceptions* of the distributions of other firms' cash flows. For example, disclosures by one firm in an industry may alter investors' beliefs about the profitability of other firms in the same industry, and thereby change their market values (Foster 1981).

Mandatory and voluntary disclosure policies do not always coincide when disclosures generate only financial externalities. Shareholders' attitudes toward risk, shareholders' relative weights in the social welfare function defining the optimal mandatory disclosure policy, and the covariance structure between firms' cash flows can all affect whether voluntary and mandatory disclosure policies coincide. However, there are a variety of circumstances in which these distinctly motivated disclosure policies do coincide when financial externalities alone exist.

These disclosure issues are studied using a "snap-shot" of an overlapping generations model (Samuelson 1958; Dye 1988) in which one generation of shareholders is forced by life-cycle considerations to sell its firms to the next generation of shareholders before the firms' cash flows are realized. Because of this forced-sale assumption, the first generation of shareholders cannot directly share in the risk of the firms' cash flows with the second generation of shareholders. However, they indirectly share in this risk by participating in the stock market on which shares are transferred from one generation to the next. Disclosure policies matter here because disclosures affect the perceived riskiness of the securities when the exchange of shares takes place, and so disclosure policies affect risk-sharing between the two generations of shareholders.

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[1] See, for example, Beaver (1977, 1981) or Gonedes and Dopuch (1974) for a summary of these efficiency arguments for and against regulated disclosures.

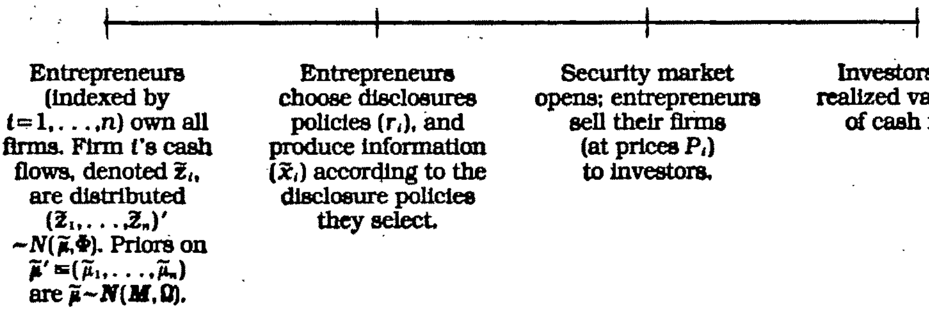
[2] For example, Hirshleifer (1971), Demski (1974), and Wilson (1975) illustrate the possibility of excessive information production by private parties.

This paper builds upon Demski (1973, 1974) who showed that (1), in general, rankings of information systems may not be complete, and (2) the selection among financial reporting systems may have redistributive consequences. These papers indicate that progress in comparing financial reporting systems depends on identifying more restricted settings where such rankings are viable. The present paper pursues this line of inquiry and reveals the following: in many contexts where comparisons of information systems are most easily made—where only financial externalities are present—mandated disclosures are superfluous, because the optimal mandated disclosures simply coincide with firms' voluntary disclosure decisions. Where comparisons of information systems are most difficult—where real externalities are present—optimal mandatory and equilibrium voluntary disclosure tend to diverge.

The paper proceeds as follows. Section I outlines the basic model. Section II provides the preliminary analysis, by studying the disclosures which "representative" market participants with common objectives make. Sections III and IV, respectively, study disclosures with financial and real externalities. Section V concludes the paper.

I. Model Description for Disclosures with Financial Externalities

The basic chronology of events corresponding to this model of disclosure requirements is summarized in the following time line:


Entrepreneurs (indexed by $i=1,\ldots,n$) own all firms. Firm i's cash flows, denoted $\tilde{z}_i$, are distributed $(\tilde{z}_1,\ldots,\tilde{z}_n)' \sim N(\tilde{\mu},\Phi)$. Priors on $\tilde{\mu}'=(\tilde{\mu}_1,\ldots,\tilde{\mu}_n)$ are $\tilde{\mu}\sim N(M,\Omega)$.
Entrepreneurs choose disclosures policies (r_i), and produce information $(\tilde{x}_i)$ according to the disclosure policies they select.
Security market opens; entrepreneurs sell their firms (at prices P_i) to investors.
Investors learn realized values $(\tilde{z}_i)$ of cash flows.

The time line is constructed to capture some aspects of an environment in which the investment horizon of current shareholders is shorter than that of future shareholders. Explicitly, the initial owners of the firms, henceforth called *entrepreneurs* (or "E's" for short), are posited to sell their ownership interests in their firms, and consume their remaining wealth, before the firms' cash flows realize their values. The eventual owners of the firms, henceforth called *investors* ("I's"), purchase the firms from the entrepreneurs and engage in consumption only after the firms' cash flows realize their values. Consequently, this model is a snapshot of an overlapping generations model in which one generation of shareholders (E's) values possession of firms only because the next generation of shareholders (I's) is willing to purchase the firms from them.[3]

In the basic model, the E's subsequently sell their firms to I's after making disclosures which reveal information about the firms' cash flows. Each of the n E's and each of the k I's are assumed to be weakly risk-averse with constant absolute risk-aversion. Entrepreneur i's expected utility function is given by $u_i(w) = -(1/\beta_i)e^{-\beta_i w}$, $i = 1, \ldots, n$, where w denotes i's wealth after receiving the proceeds from the sale of his firm. Investor i's utility function is given by $v_i(w) = (-1/\gamma_i)e^{-\gamma_i w}$, $i = 1, \ldots, k$, where w in this case denotes i's wealth after the realization of all firms' cash flows. This difference in the interpretation of the arguments of E's' and I's' utility functions devolves from the difference in their investment horizons, as discussed above.[4]

In some cases, which are explicitly noted below, the time line is expanded to include another market on which E's can trade among themselves in advance of adopting any disclosure policies.

To allow for the possibility of financial externalities, there must be some nontrivial covariance among the firms' cash flows. We assume initially that both I's' and E's' believe that the joint distribution of firms' cash flows $\tilde{\mathbf{z}}' = (\tilde{z}_1, \ldots, \tilde{z}_n)$ is n-variate normal, with unknown mean vector $\tilde{\boldsymbol{\mu}}' = (\tilde{\mu}_1, \ldots, \tilde{\mu}_n)$ and known covariance matrix $\boldsymbol{\Phi}$, and that their prior beliefs about $\tilde{\boldsymbol{\mu}}$ are identical and summarized by another n-variate normal distribution with mean vector $\boldsymbol{M}$ and covariance matrix $\boldsymbol{\Omega}$.[5]

A disclosure by entrepreneur i is represented by an unbiased estimate $\tilde{x}_i$ of the mean of firm i's unknown cash flows $\tilde{\mu}_i$, and a disclosure policy ("DP" for short) for firm i consists of a specification of the precision (i.e., inverse of variance) r_i of this sample estimate. The entrepreneur is assumed to have no private information of his own: his choice of precision r_i and the realized sample estimate x_i are public knowledge, and he acquires no information about the realized value of $\tilde{\mu}_i$ other than through the sample estimate (the appropriateness of these assumptions is discussed below). If $r_i = \infty$, entrepreneur i must reveal $\tilde{\mu}_i$; if $r_i = 0$, entrepreneur i's disclosure reveals nothing and, hence, does not affect I's' beliefs about the distribution of cash flows.

This paper studies the choice of disclosure policies, i.e., the choice of the r_i. Once the r_i have been chosen, firms are presumed to have no control over the choice of the realized values of the x_i. Thus, the paper can be viewed as the study of information system choice. This stylized representation of a firm's disclosure process captures the importance of the precision of a firm's disclosures in revising I's' perceptions of firms' cash flows. It is appropriate for studying the requirements an accounting standards board would like to impose on firms or irreversible choices (imposed by intertemporal consistency requirements) of accounting policy by an individual firm. It is not appropriate for studying voluntary earnings forecasts, where firms have control over the details of what is to be disclosed *after* receiving private information about μ_i. In such situations, signalling phenomena must be considered explicitly, whereas in our setting, signalling is irrelevant.

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[3] See Dye (1988) for other applications of overlapping generations models to accounting.

[4] We shall on occasion also consider risk-neutral E's and/or I's. Such preferences can be represented as the limit of negative exponential preferences $(-1/\beta) \times \exp(-\beta w)$, as β approaches zero.

[5] Unless otherwise noted, any vector is to be considered a column vector. Row vectors are indicated by an apostrophe. Both vectors and matrices are in boldface to distinguish them from scalars.

The assumption that E's and I's share common prior beliefs about the distribution of cash flows is adopted for two reasons. First, firms frequently commit themselves to disclosures in the future regarding information they do not possess when they make the commitment. For example, the decision to list on a particular stock exchange constitutes a commitment to make periodic disclosures about information the firm does not possess when the listing decision is made. Postulating that firms do not have superior information at the time they choose their disclosure policies is one way to model such commitments. Second, there has been substantial research documenting the disclosure policies firms would adopt if they were endowed with superior private information at the time disclosure decisions are made (e.g., Grossman 1981 and Milgrom 1981). This line of research has established that if firms cannot make false statements about their private information, then they will disclose their information fully (unless the information is proprietary) to distinguish the information they have from that possessed by other firms with worse information. We seek to distinguish the motives for disclosure in this paper from this well-known adverse selection motive.

We begin by developing an equilibrium pricing equation contingent on the disclosures firms make and the disclosure policies they adopt. Let $\tilde{\mathbf{z}}$ be the random vector describing the firms' cash flows, and let $E[\tilde{\mathbf{z}}|\mathbf{x},\mathbf{R}]$ be the vector whose ith element is the expected value of firm i's cash flows, conditional on $\mathbf{x}'=(x_1,\ldots,x_n)$, the vector of disclosures being drawn from a normal distribution with unknown mean vector $\tilde{\boldsymbol{\mu}}$ and known precision matrix $\mathbf{R}$. This matrix $\mathbf{R}$ summarizes the disclosure policies of all firms: the ith diagonal element of $\mathbf{R}$, denoted r_i, describes firm i's disclosure policy as discussed above (when there is doubt about the individual disclosure policies $\mathbf{r}=(r_1,\ldots,r_n)$ corresponding to the precision matrix $\mathbf{R}$, we shall write $\mathbf{R}=\mathbf{R}(r)$).

The theory developed below applies whether or not the off-diagonal elements of $\mathbf{R}$ are zero. But, since there is, in fact, no loss of generality in assuming that such off-diagonal elements are zero as long as—when these off-diagonal elements exist—they are taken to be given exogenously, we adopt the convention that $\mathbf{R}$ is diagonal to ease the notation in some of the proofs.[6]

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[6] The economic issue at stake which makes this diagonal representation feasible is the assumption that the off-diagonal elements in $\mathbf{R}$ are exogenously given. This seems to be a reasonable assumption: if an off-diagonal element is nonzero, it reflects the possibility that firm i's disclosures may reveal information about $\tilde{\mu}_j$, firm $j \neq i$'s unknown mean. While firms can control, and accounting standards boards can dictate, how much information a disclosure reveals about the mean of the distribution of the cash flows of the firm making the disclosure (through specification of the r's), firms have little control (and accounting standards boards would have difficulty dictating) how much information one firm's disclosure would reveal about other firms.

To see that there is no loss of generality in taking $\mathbf{R}$ to be diagonal when its off-diagonal elements

Let $\mathrm{Var}(\tilde{\boldsymbol{x}}|\boldsymbol{x},\boldsymbol{R})$ be the (posterior) covariance matrix for the joint distribution of $\tilde{\boldsymbol{x}}$, conditional on $\boldsymbol{x}$ and $\boldsymbol{R}$. Then, with "$\mathbf{1}$" denoting a (column) vector of n ones and

$$\gamma = 1 \Big/ \sum_{i=1}^{k} \frac{1}{\gamma_i},$$

the market-clearing prices $P_1, \ldots, P_n$ for the n firms are given by the well-known expression[7]

$$\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R}) = \begin{bmatrix} P_1 \\ \vdots \\ P_n \end{bmatrix} = E[\tilde{\boldsymbol{x}}|\boldsymbol{x},\boldsymbol{R}] - \gamma\,\mathrm{Var}(\tilde{\boldsymbol{x}}|\boldsymbol{x},\boldsymbol{R})\mathbf{1}. \tag{1}$$

According to standard Bayesian updating formulas (e.g., Degroot 1970)[8] $\mathrm{Var}(\tilde{\boldsymbol{x}}|\boldsymbol{x},\boldsymbol{R}) = \boldsymbol{\Phi} + (\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1}$, so equation (1) can be rewritten as:

$$\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R}) = E[\tilde{\boldsymbol{x}}|\boldsymbol{x},\boldsymbol{R}] - \gamma(\boldsymbol{\Phi} + (\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1})\mathbf{1}. \tag{2}$$

Equation (2) states that the price of every firm's securities depends on the expected cash flows conditional on what information I's know at the time the market opens minus two types of risk-premia: risk-premia attached to uncertainty about the firm's cash flows conditional on knowing the true mean of the cash flows of the securities (for firm i, if $\mathbf{1}_i$ denotes a column of zeros except for a one in the ith component, this risk premium is $\gamma\mathbf{1}_i'\boldsymbol{\Phi}\mathbf{1}$) and risk-premia attached to uncertainty about the actual realizations of $\tilde{\boldsymbol{\mu}}$ (for firm i, this is $\gamma\mathbf{1}_i'(\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1}\mathbf{1}$).

II. Disclosures with a Representative Entrepreneur and a Representative Investor[9]

Introduction

Optimal mandatory and voluntary disclosure policies solve different maximization problems. An accounting standards board, in choosing among mandatory disclosure policies, accounts for the influence one entrepreneur's disclosure policy has on (1) other entrepreneurs, and (2) all investors. In contrast,

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are zero, let $\dot{\boldsymbol{R}}$ denote the nxn matrix whose entries consist of the elements of $\boldsymbol{R}$ with 0's replacing $\boldsymbol{R}$'s diagonal elements. Also define a new matrix $\hat{\boldsymbol{\Omega}}$ by $\hat{\boldsymbol{\Omega}}^{-1} = \boldsymbol{\Omega}^{-1} + \dot{\boldsymbol{R}}$ and another nxn matrix $\boldsymbol{R}^*$ whose off-diagonal elements are zero, and whose diagonal elements are the same as the elements of $\boldsymbol{R}$. Then, it is clear by examining the pricing equation (2) below that, with $\hat{\boldsymbol{\Omega}}^{-1}$ replacing $\boldsymbol{\Omega}^{-1}$ and $\boldsymbol{R}^*$ replacing $\boldsymbol{R}$, the pricing equation remains correct, and of course, in this formulation, $\boldsymbol{R}^*$ is diagonal.

[7] This result is standard (e.g., see Stapleton and Subrahmanyam 1978).

[8] From DeGroot (1970), investors' posterior assessment of $\tilde{\boldsymbol{\mu}}$ is normal with mean $(\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1}(\boldsymbol{\Omega}^{-1}\boldsymbol{M}+\boldsymbol{R}\boldsymbol{x})$ and precision matrix $\boldsymbol{R}+\boldsymbol{\Omega}^{-1}$. Since the distribution of $\tilde{\boldsymbol{x}}$ conditional on $\tilde{\boldsymbol{\mu}}$ is normal with mean $\tilde{\boldsymbol{\mu}}$ and covariance matrix $\boldsymbol{\Phi}$, $\tilde{\boldsymbol{x}} = \tilde{\boldsymbol{\mu}} + \tilde{\boldsymbol{\epsilon}}$, where $\tilde{\boldsymbol{\epsilon}}$ and $\tilde{\boldsymbol{\mu}}$ are independent and $\tilde{\boldsymbol{\epsilon}}$ has mean (vector) zero and covariance matrix $\boldsymbol{\Phi}$. Hence, the posterior distribution of $\tilde{\boldsymbol{x}}$, conditional on $\tilde{\boldsymbol{x}}=\boldsymbol{x}$, has covariance matrix $\boldsymbol{\Phi}+(\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1}$.

[9] I wish to thank one of the anonymous referees for suggesting that I begin the analysis with the study of "representatives'" disclosure policies. Several of the results in this section are taken directly from the referee's review of an earlier draft of this paper.

an individual entrepreneur will ignore both of these potential externalities in choosing his or her disclosure policy. We wish to identify the potentially distinct effects of these two sources of differences between mandatory and voluntary disclosure policies. This section begins the formal analysis of disclosure policies by studying the special case in which all entrepreneurs have engaged in efficient risk-sharing among themselves prior to choosing their disclosure policies. The principal consequence of this assumption is that all entrepreneurs will have the same attitudes toward risk subsequent to engaging in efficient risk-sharing and, consequently, problems in achieving unanimity among entrepreneurs regarding disclosure policies disappear. This unanimity allows reference to a representative entrepreneur without ambiguity.

To achieve efficient risk-sharing among the E's, we modify the original time line by introducing a market on which E's alone may trade *prior* to making any disclosures.[10] The equilibrium portfolio of entrepreneur i in this market involves receiving an interest of β/β_i in each firm, where:

$$\beta=\left[\sum_i 1/\beta_i\right]^{-1}.$$

Hence, at the time entrepreneur i decides to choose his disclosure policy, he will seek to maximize:

$$\begin{aligned}U_i(\boldsymbol{R})&=E[(-1/\beta_i)e^{-\beta_i(\beta/\beta_i\mathbf{1}'\boldsymbol{P}(\tilde{x};\boldsymbol{R}))}]\\&=E[(-1/\beta_i)e^{-\beta\mathbf{1}'\boldsymbol{P}(\tilde{x};\boldsymbol{R})}].^{11}\end{aligned}$$

Observe that the entrepreneur's attitude toward risk is completely specified by the aggregate risk-aversion parameter β and, hence, is independent of which particular entrepreneur is being considered. For this reason, we refer to β as the risk parameter of the representative entrepreneur.

Similarly, since a market in the firms' shares opens before any investor engages in consumption in this model, an investor with risk-aversion parameter γ_i and exogenous wealth w_i winds up with fraction γ/γ_i of each firm, and consequently, obtains expected utility:

$$\begin{aligned}V_i(\boldsymbol{R})&=E[(-1/\gamma_i)e^{-\gamma_i(w_i+\gamma/\gamma_i\mathbf{1}'(\tilde{x}-\boldsymbol{P}(\tilde{x};\boldsymbol{R})))}]\\&=(-1/\gamma_i)e^{-\gamma_i w_i}E[e^{-\gamma\mathbf{1}'(\tilde{x}-\boldsymbol{P}(\tilde{x};\boldsymbol{R}))}],\end{aligned}\tag{3}$$

where:

$$1/\gamma=\sum_i 1/\gamma_i.$$

As a consequence of these observations, the analysis in this section proceeds as if we were studying a two-person economy, with one representative entrepreneur with risk parameter β and one representative investor with risk parameter γ.

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[10] Alternatively, we could allow E's to write contracts among themselves to share the proceeds from the sale of their firms, thereby forming an explicit syndicate (as in Wilson 1968). The induced preferences of each entrepreneur are the same regardless of which method of risk-sharing is chosen.

[11] This result is also standard: that entrepreneur i winds up owning fraction β/β_i of each firm when a market opens in advance of any disclosures can be seen by substituting the market-clearing price into the shareholder's demand function. Alternatively, E's induced risk-aversion can be derived from syndicate theory. When entrepreneur i is a member of a syndicate, each of the optimal syndicate contracts is linear in the syndicates' aggregate wealth, x, when entrepreneurs have constant absolute risk-aversion, with i's contract of the form $s_i(x)=\beta/\beta_i x+k_i$ for some constant k_i (see Wilson 1968).

The social welfare function used to study mandatory disclosures in this section involves a weighted average of E's' and I's' expected utilities. Letting λ and ξ be the nonnegative weights attached to the representative entrepreneur and investor respectively, this social welfare function can be written as:

$$W(\boldsymbol{R}) \equiv \lambda(-1/\beta)E[e^{-\beta\mathbf{1}'\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R})}]+\xi(-1/\gamma)E[-e^{-\gamma\mathbf{1}'(\boldsymbol{x}-\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R}))}].^{12} \tag{4}$$

Analysis

Proposition 1 presents optimal mandatory disclosure policies as a function of the weights λ and ξ. To state this proposition, we refer to explicit expressions for the expected utilities of the representative entrepreneur and investor. These expected utility calculations make use of characteristics of only the sum of the firms' securities and cash flows. The following notation simplifies the presentation of Proposition 1, by identifying some salient characteristics of these aggregates, as well as some other parameters which will be useful in obtaining closed-form expressions for the representatives' expected utilities. Thus:

$m \equiv \mathbf{1}'\boldsymbol{M}$ is the sum of the expected values of all firms' cash flows;
$\phi = \mathbf{1}'\boldsymbol{\Phi}\mathbf{1}$ is the variance in aggregate cash flows given knowledge of the true mean $\mathbf{1}'\boldsymbol{\mu}$;
$\omega \equiv \mathbf{1}'\boldsymbol{\Omega}\mathbf{1}$ is the prior variance in the mean of the aggregate cash flows;
$\nu \equiv \mathbf{1}'(\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1}\mathbf{1}$ is the posterior variance in the mean of the aggregate cash flows:

$\kappa \equiv \exp[-\beta(m-.5\beta\omega-\gamma\phi)]$;
$\delta \equiv \exp[-.5\gamma^2\phi]$.

Proposition 1: Financial Disclosures with Representative Entrepreneurs and Investors

- (i) The optimal mandatory disclosure policy (DP) consists of full disclosure for each firm if, and only if, $\lambda\kappa(.5\beta-\gamma)+.5\xi\delta\gamma\leq 0$;
- (ii) the optimal mandatory DP consists of no disclosure for each firm if, and only if, $\lambda\kappa(.5\beta-\gamma)\exp[-\beta\omega(.5\beta-\gamma)]+.5\xi\delta\gamma\exp[-.5\gamma^2\omega]\geq 0$;
- (iii) the optimal mandatory DP consists of a unique finite, nonzero level of aggregate disclosure (measured by the difference $1/\nu-1/\omega$ between the posterior and prior precisions) if, and only if, each of the inequalities listed in parts (i) and (ii) above are reversed;[13]
- (iv) the optimal mandatory aggregate level of disclosure is nonincreasing in the weight ξ placed on I's; the optimal mandatory disclosure is

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[12] We have subsumed the investor's wealth into the parameter ξ in this formulation of the social welfare function.

[13] In contrast to the uniqueness of the individual firm's disclosure policies r_i which implement the "extreme" aggregate disclosures $\nu=0$ and $\nu=\infty$, typically the individual disclosure policies which implement "interior" aggregate disclosures $\nu\epsilon(0,\infty)$ are not unique. The reason is that there are generally multiple solutions $\boldsymbol{r}$ to the equation $\mathbf{1}'(\boldsymbol{R}(\boldsymbol{r})+\boldsymbol{\Omega}^{-1})^{-1}\mathbf{1}=\nu$, as can be easily verified by example, even in the case of two entrepreneurs.

nondecreasing (nonincreasing) in the weight λ placed on E's if, and only if, $.5\beta<\gamma$ ($.5\beta>\gamma$); and

(v) if lump-sum payments are permitted between the representative entrepreneur and the representative investor, then the optimal mandatory DP evaluated at the optimal lump-sum payment entails no (full) disclosure if $\beta>\gamma$ ($\beta<\gamma$).

Abbreviated proofs appear in the Appendix. More detailed proofs are available from the author.

This proposition gives an essentially complete description of optimal mandatory disclosures when entrepreneurs have efficiently shared their risks and disclosures are costless. The implications of the proposition are easiest to understand by considering special cases:

1. The representative investor prefers no disclosure: this corresponds to the case of $\lambda=0$, so part (ii) applies.
2. (a) The representative entrepreneur prefers full (no disclosure if $.5\beta<\gamma$ ($.5\beta>\gamma$). This statement corresponds to the case of $\xi=0$, so part (i) or (ii) applies depending on whether $.5\beta<\gamma$ or $.5\beta>\gamma$.
   (b) Full disclosure uniquely maximizes the expected aggregate market value of all firms. This statement follows from 2(a) because the objective function of a risk-neutral representative entrepreneur ($\beta=0$) is to maximize the expected aggregate market value of all firms.
3. Regardless of the weights placed on E's or I's in the social welfare function, no disclosure is optimal if $.5\beta>\gamma$: this again follows from part (ii).
4. If the level of "voluntary" disclosures is determined by what the representative entrepreneur would do to maximize its expected utility, then the optimal mandatory disclosure is always weakly less than the level of voluntary disclosures: this follows immediately from part (iv).
5. When E's are risk-neutral and I's are strictly risk-averse, then (a) when there are no lump-sum payments between the representative entrepreneur and investors, full disclosure is optimal if, and only if, $.5\xi\delta\leq\lambda$. The result follows from part (i) because a risk-neutral E is approximated by letting β approach zero and, hence, $\varkappa$ converges to 1; (b) when optimal lump-sum payments are allowed, full disclosure is uniquely optimal. This follows from part (v).
6. No disclosure is always optimal when I's are risk-neutral (and E's are strictly risk-averse): this follows from $.5\beta>\gamma$ and $\varkappa$ and δ remaining positive when evaluated at $\gamma=0$.
7. Increasing investor wealth, holding all other constants fixed, (weakly) increases the optimal mandatory aggregate level of disclosure: this follows because an increase in investor wealth, *ceteris paribus*, decreases the weight ξ placed on the representative investor's preferences in the social welfare function.

Cases 1 and 2 are easy to derive and explain. To calculate an investor's expected utility, note that equation (2) yields expressions (5) and (6) below:

$$E[\mathbf{1}'(\tilde{\mathbf{z}}-\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R}))|\boldsymbol{x},\boldsymbol{R}]=\gamma\mathbf{1}'(\boldsymbol{\Phi}+(\boldsymbol{R}+\boldsymbol{\Omega}^{-1})^{-1})\mathbf{1}=\gamma(\phi+\nu) \tag{5}$$

$$\mathrm{Var}(\mathbf{1}'(\tilde{\mathbf{z}}-\boldsymbol{P}(\boldsymbol{x};\boldsymbol{R}))|\boldsymbol{x},\boldsymbol{R})=\mathrm{Var}(\mathbf{1}'\tilde{\mathbf{z}}|\boldsymbol{x},\boldsymbol{R})=\phi+\nu. \tag{6}$$

Therefore, since $\tilde{\mathbf{z}}$ given $\boldsymbol{x}$ is distributed multivariate normal, we can calculate the investor's expected utility as follows:

$$\begin{aligned}(-1/\gamma)E[\exp(-\gamma\mathbf{1}'(\tilde{\mathbf{z}}-\boldsymbol{P}(\tilde{\mathbf{x}};\boldsymbol{R})))]&=(-1/\gamma)\exp(-.5\gamma^2(\phi+\nu))\\&=(-\delta/\gamma)\exp(-.5\gamma^2\nu),\end{aligned} \tag{7}$$

Notice that I's benefit from the risk arising from uncertainty about the means of the firms' cash flows: equation (7) is increasing in the posterior variance ν. This paradoxical result occurs because the entrepreneurs are "forced" to sell all of their ownership of the risky assets at the equilibrium price and the risk premium implicit in that price exceeds the risk premium required to compensate the investors for the risk they are bearing. This can be seen formally by noting that when the aggregate mean cash flows have a posterior variance of ν, then the expected value of the market portfolio ($\mathbf{1}'E\boldsymbol{P}(\tilde{\mathbf{x}};\boldsymbol{R})=m-\gamma(\phi+\nu)$), is $\gamma\nu$ below what it would have been were there no uncertainty about the expected value of the aggregate cash flows. In contrast, the additional risk which I's bear as a result of this uncertainty has a certainty-equivalent cost of only $.5\gamma\nu$ (since $E[-\exp(-\gamma\mathbf{1}'\tilde{\mathbf{z}})|\boldsymbol{R}]=-\exp(-\gamma(\mathbf{1}'\boldsymbol{M}-.5\gamma(\phi+\nu))))$). Hence the drop in the equilibrium prices arising from increased uncertainty about the firms' cash flows outweighs I's' "costs" of bearing the associated additional risk. Consequently, if I's had exclusive control of the disclosure policies, they would insist that firms engage in no disclosure whatsoever.

To calculate the representative entrepreneur's expected utility, we use the fact that $\mathbf{1}'\boldsymbol{P}(\tilde{\mathbf{x}};\boldsymbol{R})$ is normally distributed with mean $m-\gamma(\phi+\nu)$ and variance[14] $\omega-\nu$ to conclude:

$$\begin{aligned}(-1/\beta)E[e^{-\beta\mathbf{1}'\boldsymbol{P}(\tilde{\mathbf{x}};\boldsymbol{R})}]&=(-1/\beta)\exp(-\beta(m-\gamma(\phi+\nu)-.5\beta(\omega-\nu))\\&=(-\varkappa/\beta)\exp(-\nu\beta(.5\beta-\gamma)).\end{aligned} \tag{8}$$

Now, it is clear from this expression that the representative entrepreneur's expected utility is increasing or decreasing in the posterior variance ν of the aggregate expected cash flows if, and only if, $.5\beta>\gamma$. The same offsetting factors identified above explain the economics underlying this inequality. On the one hand, the expected aggregate market value of the firms is declining at the rate $\gamma\nu$ in the posterior variance of the aggregate disclosures. This is, of course, undesirable to E's. But, on the other hand, increases in the variance of the disclosures *reduces* the risk E's experience in selling their firms, because the less informative the disclosures the less the prices of the firms change in reaction to those disclosures. Specifically, equation (8) shows that an entrepreneur with risk aversion parameter β obtains a certainty equivalent benefit of $.5\beta\nu$ from making disclosures with a posterior variance of ν. Whether no disclosure or full disclosure is optimal for the E's depends upon whether the increase in the expected selling price of the firm attainable by engaging in full disclosure outweighs the accompanying disutility of the increased variance in the selling price. This explains the role of the inequality $.5\beta>\gamma$, and hence, case 2(a).[15]

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[14] There are several ways of obtaining this expression for the variance of $\mathbf{1}'\boldsymbol{P}(\tilde{\mathbf{x}};\boldsymbol{R})$, i.e., the variance of $\mathbf{1}'E[\tilde{\boldsymbol{\mu}}|\tilde{\mathbf{x}},\boldsymbol{R}]$. One simple way is: from regression theory, $\mathbf{1}'\tilde{\boldsymbol{\mu}}=\mathbf{1}'E[\tilde{\boldsymbol{\mu}}|\tilde{\mathbf{x}},\boldsymbol{R}]+\tilde{\epsilon}$, where $\tilde{\epsilon}$ is a random variable whose covariance with $\mathbf{1}'E[\tilde{\boldsymbol{\mu}}|\tilde{\mathbf{x}},\boldsymbol{R}]$ is zero. Hence, $\mathrm{Var}(\mathbf{1}'\tilde{\boldsymbol{\mu}})=\mathrm{Var}(\mathbf{1}'E[\tilde{\boldsymbol{\mu}}|\tilde{\mathbf{x}},\boldsymbol{R}])+\mathrm{Var}(\tilde{\epsilon})$. Since $\mathrm{Var}(\mathbf{1}'\tilde{\boldsymbol{\mu}})=\omega$ and $\mathrm{Var}(\tilde{\epsilon})=\nu$ (as the posterior variance of the expected value of cash flows), we conclude $\mathrm{Var}(\mathbf{1}'E[\tilde{\boldsymbol{\mu}}|\tilde{\mathbf{x}},\boldsymbol{R}])=\omega-\nu$.

The intuition for case 2(b) where disclosures are chosen to maximize the sum of the expected market values of all firms can be described succintly. The optimality of full disclosures derives from the simple fact that aggregate market value maximization is accomplished by eliminating any risk-premium associated with I's' uncertainty about the firms' expected cash flows.

Cases 3 through 7 follow directly by recognizing that the social welfare function is a weighted average of the representative entrepreneur's and representative investor's utility functions, and hence the outcome in those cases depend upon what happens in the two initial "corner" cases.

To explain what happens in part (v) of the proposition, in which optimal lump-sum payments between the representative E and the representative I are allowed, we begin with the following fact: since both representatives have constant absolute risk-aversion, the post-redistribution social welfare function is maximized by maximizing the sum of these representatives' certainty equivalents.[16] To apply this fact to the present problem, observe from equations (7) and (8) above, that the certainty equivalent of $\mathbf{1}'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})$ for the representative E and the certainty equivalent of $\mathbf{1}'(\tilde{\boldsymbol{x}}-\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})$ for the representative I are respectively given by $C_e=\nu(.5\beta-\gamma)$ and $C_i=.5\gamma\nu$, so $C_e+C_i=.5\nu(\beta-\gamma)$. Therefore, $\nu=\omega$ ($\nu=0$) is optimal if $\beta>\gamma$ ($\beta<\gamma$).

The intuition here is this. Although a lump-sum distribution cannot explicitly transfer risk across generations, one generation can offset the effects a DP has on the risk the other generation must bear with an appropriately sized fixed payment. Therefore, given the opportunity to make such transfers, the optimal DP must maximize the sum of the expected benefits (i.e., the certainty equivalents) of the disclosures.

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[15] While it is not surprising that a comparison of the representative entrepreneur's and investor's risk parameters matters in this decision problem of the entrepreneurs (because these parameters reveal information about the tradeoff between expected selling price and increased risk), the existence of this knife-edge situation, as well as the relative size of the parameters which determine its location, are probably specific to the particular parameterization of the problem we have studied.

[16] Formally, we appeal to the following lemma.

Lemma: For arbitrary nonnegative weights $\{\aleph_i\}$, the value of the objective function of the program:

$$\max_{\{\ell_i\}} \sum_i -\aleph_i \exp(-\zeta_i(C_i+\ell_i)) \qquad \text{subject to } \sum_i \ell_i=0,$$

when evaluated at its optimum equals $-H\times\exp\left[-\zeta\sum_i C_i\right]$,

where $\zeta=1\Big/\sum_i 1/\zeta_i$ and $H=(1/\zeta)\exp\left[\sum_i(\zeta/\zeta_i)\log\zeta_i N_i\right]$.

This result is proven by elementary calculus. Here, C_i is to be interpreted as individual i's certainty-equivalent.

III. Disclosure Policies with Financial Externalities

In this section, we evaluate the individual expected utility-maximizing disclosure decisions of *undiversified* entrepreneurs in a regime where disclosures produce only financial externalities, i.e., where the disclosures at most alter outsiders' perceptions of the distributions of cash flows, but disclosures do not shift either the realized mean vector $\tilde{\boldsymbol{\mu}}$ or covariance matrix $\boldsymbol{\Phi}$ of the joint distribution of cash flows. In this and all remaining sections, we revert to the original time line in which the initial owners of the firms, the entrepreneurs, have no opportunity to share their risks with other entrepreneurs prior to making disclosures in accordance with the disclosure policies they voluntarily select.[17]

Assume that each entrepreneur chooses that policy which maximizes his or her expected utility, while taking the disclosure policies of other firms as given. An equilibrium in voluntary disclosure policies exists if each entrepreneur's perceptions of the other entrepreneurs' policies is correct, or more precisely, in the case of two entrepreneurs, if the following definition is satisfied.

Definition 1: $\mathbf{r}^*=(r_1^*,r_2^*)$ constitutes an equilibrium set of voluntary disclosure policies (with associated precision matrix $\mathbf{R}^*=\mathbf{R}(\mathbf{r}^*)$) if, for $i=1,2$:

$$E[-1/\beta_i\exp(-\beta_i\mathbf{1}'\mathbf{P}(\tilde{\mathbf{x}};\mathbf{R}^*))]\geq E[-1/\beta_i\exp(-\beta_i\mathbf{1}'\mathbf{P}(\tilde{\mathbf{x}};\mathbf{R}(\mathbf{r})))],$$

where $\mathbf{r}=(r_i,r_j^*), j\neq i$, for any $r_i\geq 0$.

This definition is simply a (pure strategy) Nash equilibrium in disclosure policies.[18]

The restriction to two entrepreneurs is made as a concession to the complexity of the mathematics in the risk-averse case. It is easy to show that the results generalize to an arbitrary number of entrepreneurs when the entrepreneurs are risk-neutral. The two-entrepreneur case permits a comparison of the attitudes of an undiversified entrepreneur toward disclosure with those of the rest of the market by interpreting one of the "entrepreneurs" as a collection of investors who have diversified positions in a large collection of firms (like the representative entrepreneur of the previous section). This case also allows determination of whether competition between E's produces different disclosures than when disclosures are imposed by fiat. The number of investors is always allowed to be arbitrary.

The next proposition is a complete description of all equilibria corresponding to virtually all parameterizations of the E's' and I's' preferences and covariance

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[17] While the formal theory provides no motivation for the absence of such risk-sharing opportunities, this nondiversification may arise because of moral hazard or adverse selection concerns. As a referee has pointed out, this exogenous assumption of nondiversification is not easily made endogenous formally, because whatever motivated the entrepreneurs to be nondiversified in the first place might provide motivation for subsequent generations of the firms' owners to be nondiversified as well. But, it is clear that many firms start out as undiversified operations that subsequently grow into publicly traded firms with highly diversified owners, and so the evolution of the ownership structure assumed here is the natural one.

[18] As the notation indicates, we do not consider equilibria for randomized disclosure policies (in which the entrepreneurs select distributions of disclosure policies in anticipation that other entrepreneurs will do likewise) in this paper.

Table 1
Equilibria for Financial Externalities[1]

(d_2^∞, d_2^0)	$(-,-)$	$(-,+)$	$(+,-)$	$(+,+)$
(d_1^∞, d_1^0)				
$(-,-)$	$(0,0)$	$(0,\infty)$	$(0,0)$	$(0,\infty)$
$(-,+)$	$(\infty,0)$	**[2]	$(-d_2^0/d_2^\infty, -d_1^0/d_1^\infty)$	$(0,\infty)$
$(+,-)$	$(0,0)$	$(-d_2^0/d_2^\infty, -d_1^0/d_1^\infty)$	***	(∞,∞)
$(+,+)$	$(\infty,0)$	$(\infty,0)$	(∞,∞)	(∞,∞)

[1] The elements of the table are (r_1, r_2).

[2] For the entries marked by asterisks, there are multiple equilibria, given by

$$** = \{(0,\infty),\ (\infty,0),\ (-d_2^0/d_2^\infty, -d_1^0/d_1^\infty)\}$$
$$*** = \{(0,0),\ (\infty,\infty),\ (-d_2^0/d_2^\infty, -d_1^0/d_1^\infty)\}.$$

Except for the parameterizations indicated by asterisks, all equilibria are unique.

structures among securities (in this proposition, $\hat{\omega}_{ij}$ is the (i,j)th element of Ω and $|\Omega|$ is Ω's determinant).

Proposition 2: Financial Externalities and Voluntary Disclosures

> *Let* $d_i^0 \equiv (\gamma-\beta_i/2)\hat{\omega}_{ii}+\gamma\hat{\omega}_{12}$, $d_i^\infty \equiv (\gamma-\beta_i/2)\times|\Omega|/\hat{\omega}_{jj}$ for $j \neq i$ and $i=1,2$. Then, every equilibrium for the case of risk-averse E's is determined by the sign of the terms d_i^0, d_i^∞ as described in Table 1.

To learn about the economics underlying Proposition 2, we start by noting that the certainty equivalent of $\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})$ for entrepreneur 1 is $CE \equiv E[\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})]-\beta_1\mathrm{Var}(\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))$. After performing some algebra and dropping terms not involving the disclosure policies $\boldsymbol{R}$, this certainty equivalent can be decomposed into a mean effect and a variance effect expressed as follows:[19]

$$CE(\text{mean}) = -\gamma(\omega_{22}+r_2-\omega_{12})/\{(\omega_{11}+r_1)(\omega_{22}+r_2)-\omega_{12}^2\},$$
$$CE(\text{variance}) = .5\times\beta_1\times(\omega_{22}+r_2)/\{(\omega_{11}+r_1)(\omega_{22}+r_2)-\omega_{12}^2\},$$

where ω_{ij} is the (i,j)th element of the *inverse* of Ω. Note that whether additional disclosure is beneficial to entrepreneur 1 is independent of the magnitude of entrepreneur 1's disclosure (i.e., the sign of the derivative of CE terms with respect to r_1 does not depend on r_1). Hence, entrepreneur 1 will typically engage in either full disclosure or no disclosure.[20] Now, if entrepreneur 2 has engaged in, say, no disclosure, then entrepreneur 1's optimal response is determined by comparing CE(mean)+CE(variance) evaluated at $r_1=0$ and $r_1=\infty$. If entrepreneur 1 selects $r_1=\infty$, then it is clear from the expression for CE(mean) that this has the effect of raising the expected price of the firm by:

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[19] The details are as follows: from equation (2) above, $E[\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})]=\mathbf{1}'\boldsymbol{M}-\gamma\mathbf{1}_1'(\Phi+(\boldsymbol{R}+\Omega^{-1})^{-1}\mathbf{1})$. To compute $\mathrm{Var}(\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))$, use $\mathrm{Var}(\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))=\mathrm{Var}(\mathbf{1}_1'E[\tilde{\boldsymbol{z}}|\tilde{\boldsymbol{x}},\boldsymbol{R}])=\mathrm{Var}(\mathbf{1}_1'(\boldsymbol{R}+\Omega^{-1})^{-1}\boldsymbol{R}\tilde{\boldsymbol{x}})$ and the fact that the priors for $\tilde{\boldsymbol{x}}$ are multivariate-normal with mean $\boldsymbol{M}$ and covariance matrix $\boldsymbol{R}^{-1}+\Omega$ to conclude that $\mathrm{Var}(\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))=(\boldsymbol{R}+\Omega^{-1})^{-1}\boldsymbol{R}(\boldsymbol{R}^{-1}+\Omega)\boldsymbol{R}(\boldsymbol{R}+\Omega^{-1})^{-1}$. Some matrix manipulations reduce this to $\mathrm{Var}(\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))=\Omega-(\Omega^{-1}+\boldsymbol{R})^{-1}$. Combining these terms we conclude $E[\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})]-.5\beta_1\mathrm{Var}(\mathbf{1}_1'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R}))=\mathbf{1}'\boldsymbol{M}-\gamma\mathbf{1}_1'(\Phi+(\boldsymbol{R}+\Omega^{-1})^{-1}\mathbf{1})-.5\times\beta_1\times\mathbf{1}_1'\{\Omega-(\Omega^{-1}+\boldsymbol{R})^{-1}\}\mathbf{1}_1$. Dropping the terms not involving $\boldsymbol{R}$ and writing out the terms of the matrix inverses in the preceding expression produces the expressions for CE(mean) and CE(variance) in the text.

[20] This explanation is informal: the proof of the proposition does not appeal to vague notions used in the text such as "typically."

$$\gamma(\omega_{22}-\omega_{12})/(\omega_{11}\omega_{22}-\omega_{12}^2)=\gamma(\hat{\omega}_{11}+\hat{\omega}_{12})$$

above what it would have been had the entrepreneur engaged in no disclosure. Offsetting this effect, the variance in the selling price is higher with full disclosure by:

$$.5\times\beta_1\times\omega_{22}/(\omega_{11}\omega_{22}-\omega_{12}^2)=.5\times\beta_1\times\hat{\omega}_{11}$$

than it would have been with no disclosure. Combining these effects, we see that full (no) disclosure is the preferred option when:

$$\gamma(\hat{\omega}_{11}+\hat{\omega}_{12})-.5\times\beta_1\times\hat{\omega}_{11}$$

is positive (negative), i.e., when d_1^0 is positive (negative). Note that since firm 2 was postulated to engage in no disclosure, firm 2's mean is uncertain at the time investors purchase the firms, and so the risk-premium investors require to purchase firm 1 depends on the covariance between the means of the firms' cash flows.

In similar fashion, it can be shown that the net benefit to entrepreneur 1 of engaging in full disclosure rather than no disclosure when entrepreneur 2 engages in full disclosure is given by d_1^∞. Note that, in this case, the covariance between firms' 1 and 2's means has no effect on the risk premium investors who purchase firm 1 receive, because, when firm 2 engages in full disclosure, there is no uncertainty about firm 2's mean.

Thus, the net benefit to entrepreneur 1, measured in terms of certainty equivalent value, of engaging in full disclosure instead of no disclosure, is given by the "d_1" terms, appropriately indexed according to whether entrepreneur 2 engages in full disclosure ($r_2=\infty$) or no disclosure ($r_2=0$). Symmetric comments obviously apply when entrepreneurs 1 and 2 are interchanged. Equilibrium requirements (such as requiring firm 1 to want to engage in full disclosure when firm 2 believes that firm 1 will engage in full disclosure) then aid in the completion of the table.

This proposition sheds light on why stock exchanges might seek to impose mandatory disclosures beyond those which newly listed firms would supply voluntarily. To see this, adopt the interpretation that entrepreneur 1 is undiversified and about to be listed on an exchange, and "entrepreneur 2" is a label for the rest of the (diversified) market. When the two generations of shareholders are similar, the aggregate risk parameters β and γ are approximately equal and both will be near zero in "large" markets. Hence, β_1 will be much larger than γ; β_2 will be approximately equal to γ; and both d_1^∞ and d_1^0 will be negative (for future reference, we refer to parameters satisfying these conditions as the "typical" case). Therefore, by Proposition 2, entrepreneur 1 will engage in no disclosure. When the covariance $\hat{\omega}_{12}$ is positive, d_2^0 will be positive, so, by Proposition 2, the rest of the market will be in favor of full disclosure. Intuitively, the risk-premium the rest of the market would forego by not engaging in full disclosure far exceeds the variance-reducing benefits of no disclosure, whereas the reverse is true for the single undiversified entrepreneur, leading to the difference in their preferred disclosure policies.

Now switch the indices 1 and 2 in the expressions for *CE*(mean) and *CE*(variance) above and differentiate their sum with respect to r_1. When $\hat{\omega}_{12}$ is positive, the result is that "the market" would prefer entrepreneur 1 to engage in full disclosure. Since it has just been seen that the undiversified entrepreneur 1 would prefer no disclosure (under the indicated parameter values), we conclude that there is tension between the disclosures the undiversified firm would like to make, and the disclosures the rest of the market will insist that it make.

If all entrepreneurs are risk-neutral, this tension disappears because in this case, full disclosure is the only equilibrium. To see this, note that risk-neutral E's are approximated by $\beta_i=0$, $i=1,2$. Therefore, sgn $d_i^\infty=$ sgn γ, and $d_i^0=\gamma(\hat{\omega}_{ii}+\hat{\omega}_{12})$, $i=1,2$. Now, since Ω is positive-definite,

$$\sum_{i,j}\hat{\omega}_{ij}$$

is positive and, therefore, at least one of d_1^0, d_2^0 is positive. Consequently, there are three entries in the table consistent with the case of risk-neutral E's (both d_1^∞ and d_2^∞ positive, and at least one of d_1^0, d_2^0 positve), and for each of these entries, $(r_1, r_2)=(\infty\,\infty)$ is the unique equilibrium. Notice that, from case 2 following Proposition 1, full disclosure is also the unique DP which maximizes the aggregate expected selling price of all firms. Hence, mandatory disclosures are indeed redundant.

But the risk-neutral case is not the only instance of the redundancy of mandatory disclosures. It is possible to show that when the social welfare function which mandatory disclosure policies are designed to maximize consists of a weighted average of the various entrepreneurs' and investors' expected utilities, the unique optimal disclosure policy for each firm entails no disclosure if $\hat{\omega}_{12}<0$ and $d_i^\infty<0$, $i=1,2$. It entails full disclosure for each firm if $\hat{\omega}_{12}>0$ and $d_i^\infty>0$, $i=1,2$, and sufficiently little weight is placed on each investor's utility function in the social welfare function.[21] Since the conditions $\hat{\omega}_{12}<0$ and $d_i^\infty<0$, $i=1,2$ imply that $d_i^0<0$, $i=1,2$, it follows from Proposition 2 that the conditions which guarantee that no disclosure is the optimal mandatory disclosure policy also guarantee that no disclosure is the unique equilibrium voluntary disclosure policy. Similarly, the conditions which guarantee that full disclosure is the optimal mandatory disclosure policy also guarantee that full disclosure is the unique equilibrium voluntary disclosure policy. These observations do not prove that optimal mandatory and equilibrium voluntary disclosure policies coincide because these conditions are not an exhaustive specification of the parameter space of triples $(d_1^\infty, d_2^\infty, \hat{\omega}_{12})$. Nevertheless, they provide some evidence of how likely it is for mandatory and voluntary disclosure policies to be congruent.

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[21] Very similar conditions yield similar conclusions when either E's' utilities alone, or both E's' and I's' utilities, are calculated after optimal lump-sum redistributions have occurred. A complete specification of these conditions, along with all relevant proofs, is available from the author.

IV. Disclosure Policies with Real Externalities

This section considers disclosure policies when disclosures made by one firm may affect some firm's (perhaps its own) distribution of cash flows. The proprietary effects of these "real" disclosures are shown to have the potential to create differences between mandatory and voluntary disclosures where none existed when attention was confined to disclosures with merely financial effects.

There are many ways disclosures may affect firms' cash flows. To motivate the relation between disclosures and cash flows used below, consider two examples: (1) a firm's announcement that next year's earnings are anticipated to be four times as large as this year's earnings is more likely to provoke other firms to enter its market the smaller the firm's forecast errors have been historically, and (2) the detailed disclosure of a firm's contingent liabilities is more likely to influence the outcome of a pending lawsuit than will a vaguely worded footnote disclosure which denigrates the merits of the lawsuit. In both examples (and in many others), whether a disclosure influences some firm's cash flows depends in part upon the accuracy of the disclosure. Such examples are the basis for the maintained assumption here that the amount by which the disclosure of information affects firms' subsequent expected cash flows varies with the precision of the disclosure.

Consistent with this assumption, we assume that, conditional on realization $\boldsymbol{x}$ of the random vector $\tilde{\boldsymbol{x}}$ drawn from the joint normal distribution $\boldsymbol{N}(\tilde{\boldsymbol{\mu}},\boldsymbol{R}(\boldsymbol{r})^{-1})$, the posterior joint distribution of cash flows is given by $\boldsymbol{N}(\boldsymbol{G}(\boldsymbol{r},\boldsymbol{x}),\ (\boldsymbol{R}(\boldsymbol{r})+\Omega^{-1})^{-1}+\Phi)$, where $\boldsymbol{G}(\boldsymbol{r},\boldsymbol{x})$ represents the pair of functions $(G_1(\boldsymbol{r},\boldsymbol{x}),\ G_2(\boldsymbol{r},\boldsymbol{x}))$. $G_i(\boldsymbol{r},\boldsymbol{x})$ denotes the ith firm's expected cash flows, conditional on the disclosures $\boldsymbol{x}'=(x_1,x_2)$ according to the disclosure policies summarized by the matrix $\boldsymbol{R}(\boldsymbol{r})$.[22] It follows from equation (2) above that, conditional on $\tilde{\boldsymbol{x}}=\boldsymbol{x}$, the equilibrium prices of the securities are:

$$\boldsymbol{P}(\boldsymbol{x};\boldsymbol{r})\equiv\boldsymbol{G}(\boldsymbol{r},\boldsymbol{x})-\gamma((\boldsymbol{R}(\boldsymbol{r})+\Omega^{-1})^{-1}+\Phi)\mathbf{1}.$$

If $\boldsymbol{G}(\boldsymbol{r})'\equiv(G_1(\boldsymbol{r}),G_2(\boldsymbol{r}))\equiv E\boldsymbol{G}(\boldsymbol{r},\tilde{\boldsymbol{x}})'$, then the expected values of the n firms are given by:

$$E\boldsymbol{P}(\boldsymbol{x})=\boldsymbol{G}(\boldsymbol{r})-\gamma((\boldsymbol{R}(\boldsymbol{r})+\Omega^{-1})^{-1}+\Phi)\mathbf{1}.$$

Disclosures generate real externalities if any component of $\boldsymbol{G}(\boldsymbol{r})$ varies with the disclosure requirements $\boldsymbol{r}$. Among the many ways in which disclosures may exhibit real externalities, two are singled out for attention: those that have firm-specific or market-wide expected cash-flow effects.

Definition 2: There are positive private returns to additional disclosures of $\tilde{\mu}_i$ if:

$$\frac{\partial}{\partial r_i}G_i(\boldsymbol{r})\geq 0,\ \text{for all } \boldsymbol{r}\geq 0.$$

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[22] Notice that, by invoking these distributional assumptions, we are assuming that the posterior variance of firms' cash flows are updated in the same way they were when disclosures generated only financial externalities.

Definition 3: There are positive market-wide returns to additional disclosures of $\tilde{\mu}_i$ if:

$$\frac{\partial}{\partial r_i} G_1(\mathbf{r})+G_2(\mathbf{r})\geq 0, \text{ for all } \mathbf{r}\geq 0.$$

If there are positive private returns to additional disclosures of $\tilde{\mu}_i$, then the expected value of i's cash flows increases with the precision of the disclosures about $\tilde{\mu}_i$. If there are positive market-wide returns to additional disclosures of $\tilde{\mu}_i$, then the sum of the expected cash flows of all firms increases with the precision of the disclosures of $\tilde{\mu}_i$. Negative private and market-wide returns to additional disclosures of $\tilde{\mu}_i$ are defined analogously.

Our first observation is that investors are indifferent to the presence of any kind of real externalities, holding fixed their knowledge of the posterior variance of the aggregate cash flows, i.e., holding fixed $\nu=\mathbf{1}'(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{1}$. This can be seen from equation (7) above. Each investor's equilibrium expected utility is independent of the mean of either any firm's cash flows or aggregate cash flows. The reason, of course, is that competition among investors bids away any benefits or costs of externalities derived from firms' disclosures. Investors are favorably affected by the presence of externalities only to the extent that the externalities induce entrepreneurs to reduce the precision of the disclosure policies they select.

Entrepreneurs are not similarly apathetic about disclosure policies. Consider first the case of an entrepreneur, say entrepreneur 1, who has diversified his or her risk prior to selecting a disclosure policy. The certainty equivalent benefit he or she derives from the disclosure policy (r_1,r_2) is:

$$(-1/\beta_1)E[e^{-\beta \mathbf{1}'\mathbf{P}(\tilde{\mathbf{Z}};\mathbf{R})}]=(-1/\beta_1)\exp(-\beta(\mathbf{1}'\mathbf{G}(\mathbf{r})-\gamma(\phi+\nu)-.5\beta(\omega-\nu)). \quad (9)$$

Observe that entrepreneurs remain unanimous about disclosure policies when they share the benefits and costs of the real externalities of their disclosures in proportion to their risk tolerances. Also, in the typical case (one condition of which is $\gamma\cong\beta$, so $\gamma>.5\beta$), it is apparent from equation (9) that the presence of positive market-wide returns to additional disclosures reinforces the risk-based incentives they have to engage in full disclosure. Negative market-wide returns obviously have the opposite effect. And, the presence of private returns to additional disclosure are relevant only to the extent that they influence the market-wide returns to disclosure.

Determining the effects of the introduction of externalities on undiversified entrepreneurs is somewhat more complex. Entrepreneur 1's certainty equivalent benefit associated with the vector $\mathbf{r}=(r_1,r_2)$ of disclosure policies is given by:

$$(\mathbf{1}_1'\mathbf{G}(\mathbf{r})+\{-\gamma(\omega_{22}+r_2-\omega_{12})+.5\times\beta_1\times(\omega_{22}+r_2)\}\times\{(\omega_{11}+r_1)(\omega_{22}+r_2)-\omega_{12}^2)\}^{-1}.$$

In the typical case where β_1 is much larger than γ and γ is near zero, we know that from a purely risk-sharing standpoint, the entrepreneur has an incentive to engage in no disclosure whatsoever. If there are negative private returns to additional disclosure, then this merely serves to reinforce the entrepreneur's incentive to engage in no disclosure. When there are positive private returns to

Table 2
Equilibria for Real Externalities

(d_2^∞,d_2^0)	(−,−)	(−,+)	(+,−)	(+,+)
(d_1^∞,d_1^0)				
(−,−)	(0,0)	(0,ι)	(0,0)	(0,ι)
(−,+)	(ι,0)	?	?	(?,ι)
(+,−)	(0,0)	?	?	(?,ι)
(+,+)	(ι,0)	(ι,?)	(ι,?)	(ι,ι)

additional disclosures by entrepreneur 1, tension exists between the mean benefits of additional disclosure and the risk-sharing costs, the net result typically being a nonzero but finite level of disclosure. For the special case in which the entrepreneurs are risk-neutral, this tension disappears and, as was the case when real externalities were presumed absent, full disclosure is the only equilibrium disclosure policy.

As a specific example of disclosures with real cash flow effects, suppose each firm experiences negative private returns to additional disclosures because there are costs of making disclosures credible. To make the disclosure more credible, the firm might have to hire a more reputable auditor to attest to the precision of the disclosures. Consistent with classical audit sampling, we shall assume that disclosure costs increase quadratically in the precision of the disclosure:

$$C(r_i)=.5\times c\times r_i^2.$$

Table 2 is the counterpart to Table 1 in Proposition 2, for this disclosure cost specification. It summarizes what can be said about equilibrium voluntary disclosure policies, on the basis of only the signs of the terms d_i^0 and d_i^∞. In this table, "ι" indicates that the equilibrium voluntary disclosure is "interior," i.e., $0<r<\infty$, and "?" indicates that whether the equilibrium disclosure policy is positive cannot be determined by knowing only the signs of the "d_i" terms.[23]

Full disclosure never occurs presently when there are at most finite benefits to disclosure, because there are infinite costs of engaging in full disclosure. Observe that when no disclosure was an equilibrium policy when disclosure costs were zero, the presence of disclosure costs merely reinforces the incentives not to engage in any disclosure, at least in all those cases in which the disclosure policy is determinant based on knowledge of the "d_i" terms.

Returning to the general case of real externalities, we now ask: how do the voluntary disclosure policies entrepreneurs select compare to mandatory policies? The answer depends on whether the entrepreneurs are diversified and on what the mandatory policies are designed to maximize. If each entrepreneur is diversified and mandatory policies maximize a weighted average of the entrepreneurs' expected utilities, then mandatory and voluntary disclosure policies will coincide, because of entrepreneurs' common attitudes about the desirability of maximizing the certainty equivalent of $\mathbf{1}'\boldsymbol{P}(\tilde{\boldsymbol{x}};\boldsymbol{R})$, measured using the aggregate risk-aversion parameter β. As was true in Section III, as the social welfare function is modified to place more weight on investors' expected utilities, the optimal amount of disclosure declines.[24] These remarks are independent of the nature of the real externalities.

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[23] The proof of this result is similar to that of Proposition 2's and is not presented here.

When entrepreneurs are undiversified, the relation between mandatory and voluntary disclosure policies depends upon how the real externalities manifest themselves. Suppose, in the "typical" parameterization, that the undiversified firm experiences negative private returns to additional disclosures and positive market-wide returns to additional disclosures. If mandatory disclosure policies maximize a weighted average of the entrepreneurs' expected utilities and sufficiently little weight is placed on the preferences of the undiversified entrepreneur, then the mandatory disclosures for the undiversified firm will strictly exceed its voluntary disclosures. In this case, the positive externalities of additional disclosures reinforce the risk-based benefits of additional disclosures identified in the previous section.[25]

One might describe the consequences of eliminating mandatory disclosure requirements here by saying that a "race to the bottom" occurs, because each undiversified firm would (immediately) reduce its disclosures if mandatory disclosure regulations were lifted. But, it is clear that a "race to the top" could emerge in which equilibrium voluntary disclosures exceed optimal mandatory disclosures, by positing that each firm experiences positive private returns to additional disclosure, but negative market-wide returns. Plausible scenarios can be constructed involving any possible combination of positive or negative private or market-wide returns to additional disclosures. Consequently, without possessing detailed *a priori* knowledge about the relation between private and market-wide returns to additional disclosures for each firm, it is difficult to surmise whether mandatory disclosures will exceed voluntary disclosures. It is easy to show that this problem arises whether or not investors are risk-averse. Hence, even if we alter the objective function of mandatory disclosure policies so that it involves only aggregate market value maximization, comparisons of mandatory and voluntary disclosures require specific information about the nature of the externalities produced by the disclosures.

V. Conclusions

This paper has compared mandatory and voluntary disclosures in a simple market economy where disclosures by one firm can alter investors' perceptions about the distributions of other firms' cash flows ("financial externalities") and possibly the actual distributions of other firms' cash flows ("real externalities"). Divergence between optimal voluntary and mandatory disclosures was shown to depend upon which form of externalities a firm's disclosures generated. The existence of "information transfers" among firms (associated with financial externalities), as documented by Foster (1981) and Olsen and Dietrich (1985) was shown, in some cases, not to be sufficient cause for regulation, because the regulated disclosures would simply coincide with the disclosures firms would make voluntarily. The situation with disclosures which exhibit real externalities turned out to be much more complicated; it was difficult to make any general statement about the relation between optimal voluntary and mandatory disclosures in such cases.

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[24] This follows because an increase in the precision of any firm's disclosures decreases the posterior variance $\mathbf{1}'(\mathbf{R}+\Omega^{-1})^{-1}\mathbf{1}$.

[25] This result obtains because, in the two-firm case, if there are negative private returns and positive market-wide returns to additional disclosures for firm 1, then this necessarily implies that firm 2's expected cash flows increase with firm 1's disclosures.

Of course, categorizing a disclosure as "real" or "financial" is in practice a nontrivial exercise. The reason for postulating that disclosures can be so labeled is that it illustrates most starkly the various consequences of adopting voluntary, as opposed to mandatory, disclosures. However, it seems reasonable to assert that some disclosures are more likely to have real effects than others. Disclosures of substantial increases in earnings forecasts, of marginal cost data, of profitability of a conglomerate by line segment, all intuitively would be judged as having potential cash-flow effects. In contrast, most accountants would probably agree that disclosure of interest and depreciation expenses, and allowances for uncollectibles, are unlikely to reveal proprietary data.

These results were derived in a highly stylized model, with parametric preferences and probability distributions. Two limitations should be noted. First, the model studied here has several stages (entrepreneurs pick disclosure policies, and then make disclosures in compliance with those policies, while investors formulate their demand functions, purchase shares, and ultimately consume firms' cash flows in proportion to share purchases), but it is basically a single-period model. Multiple disclosures with multiple rounds of trading are left for future analyses. Second, the present study does not allow investors to acquire information on their own. The distributional effects of disclosure policies in the presence of information-seeking investors have not been studied.

Appendix

Proofs of Propositions

Proof of Proposition 1

The social welfare function can be written as the following concave function:

$$W(\nu) \equiv -\lambda x/\beta \times \exp(-\beta\nu(.5\beta-\gamma)) - \xi\delta/\gamma \times \exp(-.5\gamma^2\nu).$$

The posterior variance ν of the expected aggregate cash flows can take on any value between zero (full disclosure) and the prior variance ω (no disclosure). Hence, full (resp., no) disclosure (in the aggregate—i.e., of $\mathbf{1}'\tilde{\mu}$) is optimal if, and only if, $W'(0)$ (resp., $W'(\omega)$) is negative (resp., positive). Computing these derivatives and appealing to the concavity of $W(\cdot)$ proves whether $\nu=0$ or $\nu=\omega$ in each of (i)–(iii). Completing the proofs of (i)–(iii) requires merely translating statements about the aggregate variance ν into statements about the disclosure policies r_i. Part (iv) follows immediately by observing how $W'(\nu)$ varies with λ and ξ. Part (v)'s proof can be reconstructed from the discussion following Proposition 1.

Proof of Proposition 2

We begin by computing entrepreneur *i*'s expected utility corresponding to a given set of disclosure policies.

Equation (2) in the text can be written as:

$$\mathbf{P}(\mathbf{x})=(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}(\mathbf{\Omega}^{-1}\mathbf{M}+\mathbf{R}\mathbf{x})-\gamma(\mathbf{\Phi}+(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1})\mathbf{1}.$$

Since the prior beliefs about $\tilde{\mathbf{x}}$ are $\mathbf{N}(\mathbf{M},\mathbf{R}^{-1}+\mathbf{\Omega})$,

$$E[\mathbf{P}(\tilde{\mathbf{x}})]=\mathbf{M}-\gamma(\mathbf{\Phi}+(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1})\mathbf{1},\text{ and}$$
$$\begin{aligned}\mathrm{Var}(\mathbf{P}(\tilde{\mathbf{x}}))&=\mathrm{Var}((\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{R}\mathbf{x})=(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{R}(\mathbf{R}^{-1}+\mathbf{\Omega})\mathbf{R}(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\\&=\mathbf{\Omega}(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}\mathbf{\Omega}.\end{aligned}$$

Hence, entrepreneur *i*'s expected utility is given by:

$$\begin{aligned}E[-e^{-\beta_i\mathbf{1}_i'\mathbf{P}(\tilde{\mathbf{x}})}]=-\exp[&-\beta_i\mathbf{1}_i'\mathbf{M}+\beta_i\gamma\mathbf{1}_i'(\mathbf{\Phi}+(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{1}\\&+1/2\beta_i^2\mathbf{1}_i'\mathbf{\Omega}(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}\mathbf{\Omega}\mathbf{1}_i].\end{aligned}\tag{A2.1}$$

There are several irrelevant constants in the above expression. In choosing among disclosure policies, it suffices for entrepreneur *i* to examine the disclosure policy r_i which *minimizes*:

$$q_i=\gamma\mathbf{1}_i'(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{1}+1/2\beta_i\mathbf{1}_i'\mathbf{\Omega}(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}\mathbf{\Omega}\mathbf{1}_i.\tag{A2.2}$$

The following legend summarizes the notation we use to denote the (k,l)th element of various matrices:

Matrix	(k,l)*th element*
$\mathbf{R}+\mathbf{\Omega}^{-1}$	a_{kl}
$(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}$	a^{kl}
$\mathbf{R}^{-1}+\mathbf{\Omega}$	b_{kl}
$(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}$	b^{kl}
$\mathbf{\Omega}$	$\hat{\omega}_{kl}$
$\mathbf{\Omega}^{-1}$	ω_{kl}

From Theil (1971, 33), we conclude:

$$\frac{\partial b^{kl}}{\partial r_i}=\frac{\partial b^{kl}}{\partial b_{ii}}\bullet\frac{\partial b_{ii}}{\partial r_i}=\frac{b^{ki}b^{il}}{r_i^2}.$$

Using this fact, we get:

$$\partial/\partial r_i\mathbf{1}_j'(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{1}=\partial/\partial r_i\sum_k a^{jk}=-\sum_k a^{ji}a^{ik}\text{ and}\tag{A2.3}$$

$$\begin{aligned}\partial/\partial r_i\mathbf{1}_j'\mathbf{\Omega}(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}\mathbf{\Omega}\mathbf{1}_j&=\partial/\partial r_i\sum_{k,l}\hat{\omega}_{jk}b^{kl}\hat{\omega}_{lj}\\&=\sum_{k,l}\hat{\omega}_{jk}\frac{b^{ki}b^{il}}{r_i^2}\hat{\omega}_{lj}\\&=\left(\sum_k\frac{\hat{\omega}_{jk}b^{ki}}{r_i}\right)^2.\end{aligned}\tag{A2.4}$$

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the last line following from the symmetry of $\mathbf{\Omega}$ and $(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}$.

Now observe:

$$\begin{aligned}\mathbf{R}^{-1}(\mathbf{\Omega}+\mathbf{R}^{-1})^{-1}\mathbf{\Omega}&=[\mathbf{\Omega}^{-1}(\mathbf{\Omega}+\mathbf{R}^{-1})\mathbf{R}]^{-1}\\&=(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1},\end{aligned}$$

or, component-by-component,

$$\sum_k \frac{b^{ik}\hat{\omega}_{kj}}{r_i}=a^{ij}$$

so, by symmetry,

$$a^{ij}=\sum_k \frac{\hat{\omega}_{jk}b^{ki}}{r_i}. \qquad \text{(A2.5)}$$

Therefore, by letting $j=i$ in each of expressions (A2.3) to (A2.5), we have:

$$\begin{aligned}&\partial/\partial r_i\{\gamma \mathbf{1}_i'(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\mathbf{1}+\beta_i/2\,\mathbf{1}_i'\mathbf{\Omega}(\mathbf{R}^{-1}+\mathbf{\Omega})^{-1}\mathbf{\Omega}\mathbf{1}_i\}\\&=-\gamma a^{ii}\sum_j a^{ij}+\beta_i/2(a^{ii})^2\\&=a^{ii}\left((\beta_i/2-\gamma)a^{ii}-\gamma\sum_{j\neq i}a^{ij}\right). \qquad \text{(A2.6)}\end{aligned}$$

Now, we appeal to the assumption that there are only two entrepreneurs,

$$\begin{aligned}\begin{pmatrix}a^{11}a^{12}\\ a^{21}a^{22}\end{pmatrix}&=(\mathbf{R}+\mathbf{\Omega}^{-1})^{-1}\\&=\frac{1}{(\omega_{11}+r_1)(\omega_{22}+r_2)-\omega_{12}^2}\begin{pmatrix}\omega_{22}+r_2 & -\omega_{12}\\ -\omega_{21} & \omega_{11}+r_1\end{pmatrix}.\end{aligned}$$

Thus, if $i=1$, expression (A2.6) has the same sign as:

$$(\beta_1/2-\gamma)(r_2+\omega_{22})+\gamma\omega_{12}, \qquad \text{(A2.7)}$$

since $a^{ii}>0$ and $(\omega_{11}+r_1)(\omega_{22}+r_2)-\omega_{12}^2>0$ (as the determinant of the positive-definite matrix $(\mathbf{\Omega}^{-1}+\mathbf{R})$). Consequently, r_1 is either zero or infinity as this expression is positive or negative. Similarly, r_2 is either zero or infinity as:

$$(\beta_2/2-\gamma)(r_1+\omega_{11})+\gamma\omega_{12} \qquad \text{(A2.8)}$$

is positive or negative.

The two expressions (A2.7) and (A2.8) completely determine the equilibrium of this voluntary disclosure game. We will illustrate how one verifies this in two cases; the remaining cases are proven analogously. We begin by letting $e_i=\beta_i/2-\gamma$, $g_i=(\beta_i/2-\gamma)\omega_{jj}+\gamma\omega_{12}$, for all i and $j\neq i$. With this notation, r_1 is 0 or ∞ as:

$$g_1+e_1r_2 \qquad \text{(A2.9)}$$

is positive or negative; r_2 is 0 or ∞ as:

$$g_2+e_2r_1 \tag{A2.10}$$

is positive or negative.

Claim 1:

(a) $e_1,g_1>0$ and $g_2>0$ implies $(r_1,r_2)=(0,0)$ is the unique equilibrium.

(b) $e_1,g_1>0$ and $g_2<0$ implies $(r_1,r_2)=(0,\infty)$ is the unique equilibrium.

Proof: $e_1,g_1>0$ and $r_2\geq 0$ imply expression (A2.9) is positive, so $r_1=0$. Substituting $r_1=0$ into expression (A2.10), we see $r_2=0$ or ∞ as g_2 is positive or negative.

Claim 2: $e_1,e_2>0$ and $g_1,g_2<0$ imply each of: $(r_1,r_2)=(\infty,0)$, $(0,\infty)$, $(-g_2/e_2,-g_1/e_1)$ is an equilibrium, and there are no other equilibria.

Proof: We start by showing that there are no equilibria other than those listed.

Suppose $r_1=-g_2/e_2$ is part of some equilibrium (r_1,r_2).

If $r_2>-g_1/e_1$, then $g_1+e_1r_2>0$. By expression (A2.9), it follows that r_1 must be zero. This contradicts $r_1=-g_2/e_2$.

If $r_2<-g_1/e_1$, then r_1 must be ∞ by expression (A2.9), which is another contradiction. Thus, the only possible r_2 consistent with $r_1=-g_2/e_2$ is $r_2=-g_1/e_1$.

Now suppose $r_1>-g_2/e_2$ is part of an equilibrium. By expression (A2.10), it follows that $r_2=0$. But then $g_1+e_1r_2=g_1<0$, so $r_1=\infty$. So the only equilibrium (r_1,r_2) consistent with $r_1>-g_2/e_2$ is $(r_1,r_2)=(\infty,0)$.

Finally, suppose $r_1<-g_2/e_2$ is part of an equilibrium. Then $r_2=\infty$ by expression (A2.10) which implies $r_1=0$ by expression (A2.9). So $(r_1,r_2)=(0,\infty)$ is the only possible equilibrium with $r_1<-g_2/e_2$.

Verification of this claim is completed by establishing that each of the three candidate equilibria identified above are in fact equilibria. This verification procedure is straightforward and omitted.

To complete the proof of the proposition, we must convert the variables e_i,g_i, which are expressed in terms of the elements of the *inverse* of Ω into the variables d_i^0,d_i^∞ used in the text, which are expressed in terms of the elements of Ω. Recalling our notation, it is easy to show that:

$$g_1=(\omega_{11}\omega_{22}-\omega_{12}^2)[(\beta_1/2-\gamma)\hat{\omega}_{11}-\gamma\hat{\omega}_{12}],$$

so

$$\operatorname{sgn} g_1=\operatorname{sgn}(\beta_1/2-\gamma)\hat{\omega}_{11}-\gamma\hat{\omega}_{12}\equiv-\operatorname{sgn} d_1^0.$$

Similarly, $\operatorname{sgn} g_2=-\operatorname{sgn} d_2^0$.

Finally, it is obvious that $\operatorname{sgn} e_i=-\operatorname{sgn} d_i^\infty$.

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Acquisition Accounting Method and Bid Premia for Target Firms

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ABSTRACT: Previous research suggests that certain benefits may derive from the method used to account for business combinations and may affect how bidding firms structure and classify corporate acquisitions. This paper investigates whether benefits derived from accounting method are reflected in bid premia for target firms. Three estimates of bid premia are examined in 95 stock-for-stock acquisitions, 59 accounted for as poolings, and 36 accounted for as purchases. Sampling restrictions, covariance analysis, and a nonparametric matched pair comparison control for potentially confounding variables identified from prior research on bid premia determinants. The results show an association between acquisition accounting method and bid premia for target firms.

RESEARCHERS have investigated the association of such factors as taxation, method of financing (cash vs. equity), and method of acquisition (tender vs. merger) with the premia paid for target shares.[1] However, the association between method of accounting for an acquisition and the premium paid for target shares has not been explored.[2] By analyzing bid premia in a sample of stock-for-stock acquisitions, this study presents descriptive evidence of an association between the acquisition accounting method and premia paid for the common stock of target firms.

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The remainder of the paper is divided into four sections. Section I reviews prior accounting research and identifies factors that may influence the association between accounting method and bid premia. Section II describes the control variables, the sample, and the premium estimates. Section III describes the empirical tests and presents the results. Concluding comments are in Section IV.

I. Prior Accounting Research

The use of the pooling of interests method of accounting for corporate combinations is a controversial accounting policy issue.[3] The controversy relates mainly to how the differential between the price paid for the target's common stock and the book value of common stockholders' equity on the target's balance sheet is accounted for on the financial statements of the combined entity. This differential is not recognized under the pooling method of accounting for a corporate combination. On the other hand, the purchase method recognizes the differential by adjusting the target's recorded assets and liabilities to fair market values and assigning the balance to goodwill.[4] Effective for business combinations consummated after October 31, 1970, APBO No. 16 established 12 restrictive criteria that a merger must meet in order to be classified as a pooling.

Generally, when the differential is positive (negative), the pooling (purchase) method results in greater reported earnings and lower net assets for the combined entity. Gagnon (1967) was the first to test an income maximization hypothesis as a decision rule for predicting the acquisition accounting method. The income maximization hypothesis is symmetric. It predicts that when the differential is positive (negative) the pooling (purchase) method will be used to account for the acquisition, and the more positive (negative) the differential the more likely the pooling (purchase) method will be used.

The results of Gagnon (and others who have tested the income maximization hypothesis) are summarized in Table 1. The results generally support the hypothesis, but they are not symmetric. That is, when the transaction is structured as a pooling the sign of the differential is generally positive, but when the purchase method is used the differential is also generally positive.[5] Gagnon (1967) also evaluated the relation between the amount of the differential and the probability of pooling. His results support the income maximization hypothesis, but again they are not symmetric. When the differential is positive the probability of pooling increases with increases in the differential. However, when the differential is negative, the probability of purchase does not increase with decreases in the amount of the differential.

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[1] See Niden (1988) for a recent effort and a review of the literature.

[2] In the literature and in this paper, corporate acquisition, business combination, and merger are used interchangeably.

[3] See Leftwich (1981) for a review of the APB's unsuccessful attempt to eliminate the pooling method.

[4] If the balance is negative, APBO No. 16 (1970) requires that it be allocated proportionately among the target's noncurrent assets (except long-term investments in marketable securities).

[5] Nathan's (1988) results are the only ones where the majority of purchases involve a negative differential. But his results are still asymmetric, because a majority of the mergers with negative differentials are accounted for as poolings.

Table 1
Summary of Prior Tests of the Income Maximization Hypothesis for Merger Accounting

		Poolings			*Purchases*			*Total*	
Author(s)	*Time Period*	*P>B*	*B>P*	*IM*	*P>B*	*B>P*	*IM*	n	*IM*
Gagnon (1967)	1955–1956	94	18	83.9%	90	17	15.9%	219	50.7%
Copeland and Wojdak (1969)	1966–1967	101	4	96.2%	8	5	38.5%	118	89.8%
Anderson and Louderback (1975)	1967–10/31/70	100	2	98.0%	8	4	33.3%	114	91.2%
	11/1/70–1974	53	1	98.1%	8	2	20.0%	64	85.9%
Crawford (1987)[•]	1971–1982	81	8	91.0%	67	27	28.7%	183	59.0%
Nathan (1988)	1963–10/31/70	141	23	86.0%	4	6	60.0%	174	84.5%
	11/1/70–1978	85	18	82.5%	8	16	66.7%	127	79.5%

Notation: IM represents the percentage of observations consistent with the income maximization hypothesis; *P* is the author's estimate of the price paid for the target's common stock; *B* is the author's estimate of the book value of the target's common stock at the time of merger; *P>B* indicates a positive differential; and *B>P* indicates a negative differential.

[•] To be consistent with the other studies, only the nontaxable transactions in Crawford's sample are reported above.

Two factors may affect the association between accounting method and bid premia for target stock. First, the association may depend on the extent to which economic benefits derived from the acquisition accounting method influence bid premia. If there is asymmetry in the costs associated with structuring mergers to qualify for purchase or pooling accounting, there may be an association between bid premia and accounting method. Second, bid premia and accounting method may be jointly determined. This will affect the interpretation of any observed association between the two. These factors are discussed below.

Economic Benefits Derived from Acquisition Accounting Method

Copeland and Weston (1988, 365) note that there is no difference in cash flows between poolings and (nontaxable) purchases. Since cash flows, not reported earnings, are the relevant information used by investors to value the firm, they argue that there is no economically rational basis for the preference management apparently has for pooling. Crawford (1987), however, suggests several possible economic explanations for managers' preference for pooling. His arguments broaden and refine the decision rule for predicting accounting method preference. Crawford states (p. 35), that in cases where the differential is positive (negative), the probability of a pooling (purchase) increases with:

1. increases in the impact of accounting numbers on management compensation;
2. increases in the costs imposed by dividend restrictions in the bidder's debt covenants;
3. decreases in the costs imposed by financing policy constraints in the bidder's debt covenants; and
4. decreases in the political cost of reported earnings.

Crawford (p. 109) reports results "consistent with the hypothesis that managers consider the effect on their compensation packages when they choose a merger's structure . . . (and) . . .weakly consistent with the hypothesis that merger structure is influenced by the presence of debt covenants."[6]

If a merger is structured in a manner to obtain significant economic benefits derived from an accounting method, then the benefits derived from using that accounting method may be reflected in the premia paid for target shares. This proposition is consistent with Jensen and Ruback's (1983) view of the market for corporate control as an arena in which management teams compete for the benefits associated with acquisitions. It is also consistent with the empirical evidence generally showing that the benefits of mergers are captured primarily by the shareholders of the target firm.[7]

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[6] Larcker and Balkcom (1984) provide empirical evidence that managers select acquisitions in a manner consistent with the incentives in their compensation contracts. Leftwich (1981) found that bidding firms involved in acquisitions accounted for as poolings experienced negative abnormal returns during the time the APB considered the elimination of the pooling method. He suggests that these results may have been partially due to the potential elimination or curtailment of flexibility through pooling to transfer wealth from bondholders to stockholders.

[7] For example, Bradley et al. (1988) found that more than 80 percent of the merger gains observed in their sample of 236 successful interfirm tender offers between 1958 and 1984 were captured by the shareholders of the target firms.

Asymmetry in the Costs Associated with Structuring Mergers to Qualify for Purchase or Pooling Accounting

An association between bid premia and accounting method may not exist even if the benefits associated with accounting method are reflected in bid premia. For example, if bidders can obtain the benefits derived from accounting method at the same cost by using the pooling method when the differential is positive as they can by using the purchase method when the differential is negative, then *ceteris paribus*, premia paid in pooling transactions should equal premia paid in purchase transactions. However, the research summarized in Table 1 exhibits evidence of asymmetry in the purchase-pooling dichotomy. That is, while pooling transactions are generally consistent with income maximization, purchase transactions are not. This lack of symmetry may be caused by the costs of structuring an acquisition as a pooling of interests.

Before APBO No. 16 prescribed specific criteria for pooling, bidders had to convince their auditors that pooling was appropriate (Gagnon 1967, 189). This may have created a cost of pooling that some bidders may not have been willing or able to incur. Gagnon also noted that approval for poolings seemed to have become easier to obtain after his sample period and he predicted that the study of subsequent time periods would find a greater incidence of poolings. This prediction motivated Copeland and Wojdak's (1969) study of the 1966–1967 time period. While they did find a much greater incidence of poolings with positive differentials, eight of the 13 purchases in their sample also involved a positive differential. Thus, the support for the income maximization hypothesis increased, but the asymmetry in the results persisted.

Anderson and Louderback (1975, 340) sought "to determine whether the stricter requirements for the use of the pooling-of-interests method set forth in Opinion 16 inhibited income maximizing behavior on the part of management." As Table 1 shows, 98 percent of the post-APBO No. 16 poolings in their sample involve a positive differential, but only 20 percent of the post-APBO No. 16 purchases involve a negative differential. The following comment may at least partially explain the persistent asymmetry.

> If the purchase treatment was desirable, it would be relatively easy [low cost] to violate one or more of the conditions for pooling, forcing the transaction to be accounted for as a purchase (Anderson and Louderback 1975, 343).

Thus, because it may be quite costly to qualify for the pooling treatment, relative to bidders using the purchase method it is more likely that bidders using the pooling method are obtaining economic benefits derived from accounting effects.[8] A bidder that structures a merger as a pooling may be willing to incur an opportunity cost associated with satisfying one or more APBO No. 16 criteria in order to obtain benefits derived from accounting effects. Bidders in the purchase group are less likely to prefer purchase accounting for benefits derived from accounting effects. Bidders may use the purchase method either because: (1) they do not have characteristics, such as those described by Crawford (1987), that combine with accounting effects to produce benefits from the accounting method; or (2) other nonaccounting-related benefits associated with actions that violate one or more APBO No. 16 criteria outweigh any opportunity costs to those firms of using the purchase accounting method. Thus, given the higher costs of meeting the pooling requirements, the average benefits derived from accounting effects are expected to be greater for bidders using the pooling method.[9]

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[8] Nathan (1988) notes that in over half of the post-APBO No. 16 poolings in his sample, the proxy stated that the use of pooling was a condition of the merger. In the pre-APBO No. 16 era, Gagnon notes that several of the mergers in his sample were made contingent on the availability of the pooling treatment. Also see Wyatt (1967), FASB (1976, par. 880), and Langer (1976).

Joint Determination of Bid Premia and Accounting Method

Bid premia and accounting method may be jointly determined. This may occur if nonaccounting-related bid premia determinants (including those that correspond to opportunity costs of qualifying for the pooling treatment) differ systematically between poolings and purchases. For example, mergers accounted for as poolings may systematically involve higher value targets, because higher bid premia for higher value targets increase the differential and, correspondingly, the probability of pooling.[10] Thus, an association may exist between bid premia and accounting method, but the cause and effect may be from bid premia to accounting method preference rather than from structuring mergers to qualify for the preferred accounting method to higher bid premia. Wyatt (1967, 212) first pointed out this identification problem in his discussion of Gagnon's paper:

> . . . the accounting treatment is one of the variables that must be firmed up before the final price (in terms of exchange ratios) is determined. What this means is that the value imputed to goodwill based upon the value of the shares exchanged in a pooling combination is quite an artifical value. Only rarely would such value be that which would actually result had the transaction been effected as a purchase.

Nathan (1988, 187) goes further to suggest that acquiring firms may be willing to pay more in terms of higher bid premia when they use pooling, because the restrictive requirements in APBO No. 16 make it almost impossible to pool without the cooperation of the target management. Gagnon (1967, 198), Sapienza (1967, 209), and Copeland and Wojdak (1969, 194) also indicate that the price paid for the target firm depends, in part, on the accounting method.

In summary, there are two reasons one might expect to observe an association between bid premia and accounting method. First, bidders are willing to pay for the benefits derived from accounting method, and accounting-related benefits are expected to be greater, on average, in mergers accounted for as poolings. Second, accounting method and bid premia are jointly determined. An observed association could be due to either or both of the above reasons. This study investigates the association between bid premia and accounting method. It attempts to identify and control for the determinants of bid premia other than those that derive from accounting effects, but the controls are by no means perfect. Therefore, interpretation of any association observed between accounting method and bid premia must be qualified.

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[9] Another possible reason for the asymmetry in the results in Table 1 is that the benefits dependent on accounting method are not symmetric. For example, APBO No. 16 requires that poolings combine the retained earnings of the target and bidder corporations, whereas the purchase method only records the retained earnings of the bidder. If a bidder prefers higher income and higher retained earnings (e.g., to increase slack in debt covenants constraining dividends), there may be a greater chance for an unambiguous preference for pooling when the differential is positive than for an unambiguous preference for purchase when the differential is negative.

[10] It is also possible that purchases systematically involve higher value targets because, for example, bidders may not be able to acquire certain high value targets without violating one or more of the pooling criteria.

II. Control Variables, Sample, and Premium Estimates

Control Variables

The finance literature indicates that bid premia depend on the expected benefits and risks of the merger, as perceived by the market for control of the target, and on the competitiveness within that market. Prior research provides insight for purposes of identifying potentially confounding economic differences between acquisitions accounted for as poolings and those accounted for as purchases. Also, any factor associated with the net value of an acquisition and related to one of the 12 APBO No. 16 criteria creates an opportunity cost of pooling which may differ across various bidder-target combinations. Thus, control variables are identified below with reference to prior research on bid premia determinants and to the APBO No. 16 requirements.

APBO No. 16 states that if the acquirer does not issue its own voting common stock in exchange for at least 90 percent of the voting common stock of the target, the acquisition must be accounted for as a purchase. Fishman (1989) argues that bidders use cash when they are well-informed about the high value of the target in order to preempt competition. Niden (1988), Franks et al. (1988), and Asquith et al. (1987) provide strong empirical evidence that when the method of payment for the target's stock is cash (as opposed to stock) the bid premium is higher. Thus, payment method affects both bid premia and accounting method and would tend to bias test results against finding a positive relation between bid premia and the pooling accounting method. The method of payment is controlled in this study by limiting the sample to stock-for-stock acquisitions.

Shareholder taxability is another variable suggested as a potential determinant of bid premia. Taxability is also related to method of payment and, therefore, to acquisition accounting method. When the differential is positive, taxable mergers may provide a net tax benefit to the bidder in the form of a step-up in the basis of the assets acquired.[11] For tax purposes an exchange for common or preferred stock is generally nontaxable, and poolings are virtually always nontaxable. It is much more likely to find a nontaxable purchase than a taxable pooling because of the APBO No. 16 criteria that restrict pooling for reasons other than method of payment. While it is not clear how taxation of target shareholders may influence the relation between bid premia and accounting method, this study is consistent with the studies listed in Table 1 in that it controls for the tax treatment of mergers by limiting the sample to nontaxable purchases and poolings.[12]

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[11] See Crawford (1987, 40–45) for an analysis of the interactive importance of the tax and form of payment variables.

Bradley et al. (1988) found that returns to target shareholders increase with the percentage of target shares acquired. Since bidders must acquire 90 percent of the target's stock to use the pooling method, the percent of the target's stock acquired is another variable that may affect both accounting method and bid premia. This factor would tend to bias test results in favor of a positive relation between bid premia and the pooling method and, therefore, the sample in this study is limited to transactions for which 100 percent of the target's stock is acquired.

Jensen's (1986, 1988) free cash flow theory suggests that high liquidity and low leverage indicate high agency costs and bidders may have more to gain (in terms of reducing agency costs) by acquiring overly liquid or under-levered firms. Furthermore, Walkling and Edmister (1985) suggest that the cost of redeploying highly liquid assets is less than the cost of redeploying less liquid assets and that reducing a firm's excess assets increases financial performance. Walkling and Edmister also note that a tax savings from the judicious use of debt is commonly accepted. Although liquidity or leverage is unlikely to be systematically related to accounting method, higher premia are expected in acquisitions of targets with higher liquidity and lower leverage.

A relatively low preacquisition ratio of market-to-book value of target equity may indicate target management inefficiency. Replacing inefficient target management is one commonly cited source of potential benefits from a merger (Jensen and Ruback 1983; Morck et al. 1988; Jensen 1988). Nathan (1988) points out that the sign and size of the differential is also highly correlated with the preannouncement ratio of market-to-book value of the target's equity and he provides empirical evidence of an inverse relation between that ratio and premia paid for target shares (also see Walkling and Edmister 1985).[13] The accounting literature reviewed in Section I provides evidence that, for equity-financed acquisitions, the propensity toward pooling increases with the sign and size of the differential. Thus, the target's preannouncement market-to-book value ratio may be related to both bid premia and accounting method and would tend to bias test results against finding a relation between bid premia and the pooling method.

Gort and Hogarty (1970) reasoned that the larger the target relative to the bidder, the greater the risk of serious earnings dilution if the target performs poorly. They predicted and found that the relatively larger targets in their sample received lower premia. In a much larger sample of acquisitions in the U.K. between 1955 and 1985, Franks and Harris (1988) also find a significant inverse relation between bid premia and the relative size of the target. The relative size of the target may also indirectly affect the accounting method because the bidder may be less inclined to use voting common stock to acquire a relatively large target. The use of preferred stock may allow the bidder to retain more control of the combined firm, but it would also require the use of the purchase accounting method. Thus, relative size would tend to bias test results in favor of a positive relation between bid premia and the pooling method.

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[12] Empirical findings on the relation between the taxability of the acquisition and premia for target shares are mixed. Robinson (1987) found significantly higher returns to the shareholders of target firms associated with taxable acquisitions. On the other hand, after controlling for method of payment, Niden (1988) did not find a significant effect of the tax status of acquisitions on the premia paid for target shares.

[13] Nathan (1988) attempted to test the relation between the amount of the differential and the premia paid in acquisitions accounted for as poolings. He found a negative association which may mean that management inefficiency outweighs accounting method in explaining bid premia.

Walkling and Edmister (1985) argue that the bidder's preannouncement holdings of the target's common stock should be inversely related to the bid premium, because the initial holdings improve the bidder's bargaining power. If the increased bargaining power restricts competition for control of the target, then bid premia should vary inversely with the amount of initial holdings. Walkling and Edmister's empirical results support this proposition.[14] On the other hand, Franks and Harris (1988) found *higher* returns for targets whose successful bidders held target shares before merger negotiations began. Franks and Harris (p. 23) suggest the possible explanation that "toeholds are... evidence of a bidder's preparation for what is expected to be a competitive bidding process." Thus, additional returns to target shares at the merger announcement date may reflect market anticipation of competing bids. The amount of the bidder's initial holdings of target voting stock is an important control variable because APBO No. 16 precludes the pooling treatment for acquisitions involving initial holdings greater than ten percent. Although it is related to both accounting method and bid premia, it is not clear how initial holdings may affect the relation between accounting method and bid premia.

To summarize, bid premia and, through the amount of the differential, the acquisition accounting method may be influenced by method of payment (cash or stock), tax treatment, the percentage of the target's stock acquired, the target's liquidity, the target's leverage, the target's preannouncement market-to-book value ratio, the relative size of the target to the bidder, and the bidder's initial holdings of target voting stock. Furthermore, several of these variables are related to the APBO No. 16 requirements and reflect opportunity costs of pooling. To the extent that these intervening variables are not effectively controlled, any association between bid premia and accounting method will be difficult to interpret. The first three of these variables are controlled here through the sampling procedure. The influence of the other variables are controlled using a multivariate regression and a matched-pair design described in Section III.

Sample

The sample was derived from all acquisitions occurring during the period, 1972–1982, that could be identified from the COMPUSTAT Industrial Research File. To control for method of payment, tax treatment, and the percentage of target stock acquired, the sample was restricted to nontaxable stock-for-stock combinations in which the bidder exchanged either common or preferred stock for 100 percent of the target firm's voting common stock. In addition, the sample was restricted to: acquisitions involving a target and bidder with daily security

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[14] Shleifer and Vishny (1986) develop a model that also predicts an inverse relation between bid premia and initial bidder holdings.

Table 2
Sample Derivation and Composition

Acquisitions of control identified from COMPUSTAT Industrial Research File, 1972–1982	604
Acquisitions that were not completely nontaxable, stock for stock acquisitions of 100% of target voting stock	−397
Acquisitions involving a target or bidder that did not have daily security returns listed on the CRSP file	−62
Acquisitions with other important data missing (i.e., accounting method not disclosed, tax status not disclosed, or announcement of possible merger not in the *WSJ*)	−43
Acquisitions involving targets that spun off subsidiaries within 40 days preceding the first *WSJ* announcement of possible merger	−7
Acquisitions in final sample	95
Acquisitions in final sample accounted for as purchases	36
Acquisitions in final sample accounted for as poolings	59
Acquisitions in final sample	95

returns on the CRSP tapes; acquisitions announced in *The Wall Street Journal* (*WSJ*); and acquisitions with enough publicly available information to ascertain the accounting method and tax status. Finally, acquisitions involving a target that spun off a subsidiary within 40 trading days preceding the first *WSJ* announcement of a possible merger were eliminated.[15] Table 2 shows how application of these restrictions resulted in the final sample of 95 acquisitions, 36 accounted for by the purchase method and 59 accounted for as poolings of interests.

Premium Estimates

To minimize the sensitivity of the tests to the choice of estimator and to the time period used for estimation, three models were used to estimate premia paid to target shareholders. The first estimates the premium directly from the bidder's offer price at the announcement date. The second estimates the premium indirectly from returns on the target's common stock from a preannouncement date to the merger consummation date. The third estimates the market's expectation of the premium amount from an abnormal returns model that evaluates the market reaction to the news of the bid for the target stock. The three models are explained below, and Figure 1 illustrates the models on a time line.

The direct premium estimate (*DPREM*) is determined by:

$$DPREM_f = [(SR)(P_{B,0})/P_{T,-40}] - 1 \tag{1}$$

where:

SR is the final swap ratio, the number of bidder shares exchanged for each target share upon merger consummation;[16]

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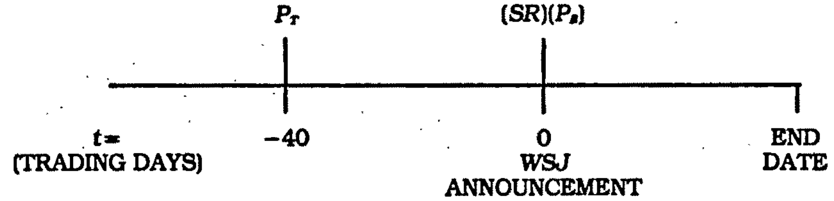
[15] Significant abnormal returns associated with divestitures is well-documented (Smith 1986, table 4). Note our test period extends from 40 days before the announcement date.

[16] The swap ratio that was initially announced was subsequently revised for eight acquisitions. The analysis was replicated without these observations, and the results were essentially unchanged.

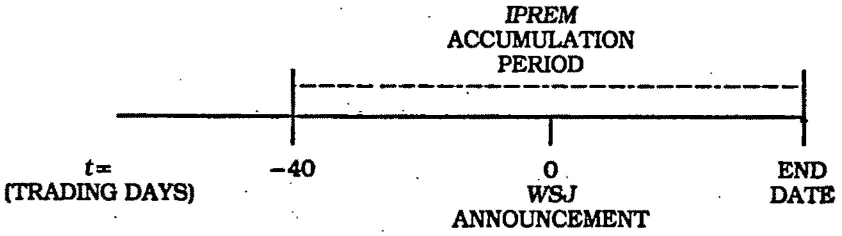
Figure 1

Dates and Time Periods in Bid Premia Estimation

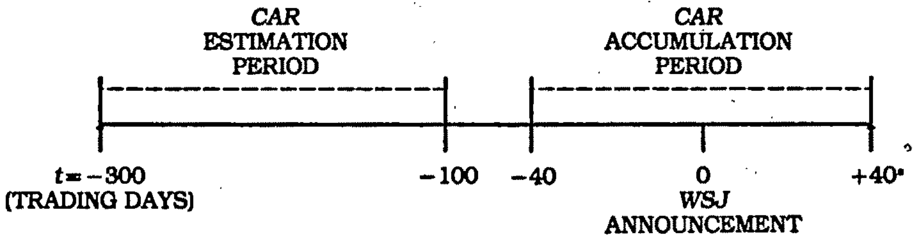
Panel A. $DPREM_f = [(SR)(P_{B,0})/P_{T,-40}] - 1$



Panel B. $IPREM_f = \left[\prod_{t=-40}^{e}(1+r_{f,t})\right] - 1$



Panel C. $CAR_f = \sum_{t=-40}^{L}(u_{f,t})$



Notation: *SR* represents the swap ratio of bidder shares exchanged for target shares; *P* is the price of the target common stock, *T*, or the bidder common stock, *B*; *t* represents the trading day relative to day 0, the announcement of an acquisition in the *WSJ*; *r* is the raw return on target firm *f*'s common stock; *e* is the last trading day before the consummation of the acquisition and delisting of the target stock; *L* is the earlier of the firms' last trading day or 40 days after the announcement date; and *u* is the deviation of firm *f*'s continuously compounded return from the firm's mean daily return during the estimation period.

[a] The last day, *L*, may occur prior to $t = +40$, and in this sample three acquisitions (two poolings and one purchase) ended from one to three days prior to this date.

$P_{B,0}$ is the price per share of the bidder's common stock at the announcement date, which is the date of the first *WSJ* article identifying the possibility of an acquisition;[17] and

$P_{T,-40}$ is the (preannouncement) price of the target's common stock, 40 trading days before the announcement date.

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[17] The announcement date was ascertained by identifying from the *WSJ Index* the first announcement of any potential acquisition of the target firm. Where an announcement was followed by six months without acquisition activity, it was deemed abandoned and the next announcement date was used.

Direct premia estimation using equation (1) is viable when the bidder's actively traded common stock is the medium of exchange. In this study's sample of stock-for-stock acquisitions, there are 13 cases where the bidder financed the acquisition with preferred stock.[18]

The indirect premium estimate, *IPREM*, is defined in equation (2) below and does not depend on the issue of common stock by the bidder. *IPREM* is derived for each target firm from the cumulative return on the target's common stock from 40 trading days before the merger announcement date to the day the stock was delisted because of the merger.

$$IPREM_f=\left[\prod_{t=-40}^{e}(1+r_{f,t})\right]-1 \tag{2}$$

where:

$r_{f,t}$ is the raw return on the common stock of target firm f on day t; and
e is the number of trading days between the announcement date and the delisting date.

Because *IPREM* extends through completion of the merger, differences between *IPREM* and *DPREM* could result from either: (1) a change in the price of the bidder's stock between the announcement date and the merger consummation date; or (2) dividends paid on the target's stock from 40 trading days before the announcement date to the merger consummation date. A mean-adjusted abnormal returns model is used in equation (3) below to estimate the market reaction to the news of the bidder's offer for the target stock. The market reaction (*CAR*) is estimated during a test period beginning 40 trading days before the announcement date and ending on the earlier of the fortieth trading day after the announcement date or the last day of trading of the target's stock before the merger consummation. That is:

$$CAR_f=\sum_{t=-40}^{L}(u_{f,t}) \tag{3}$$

where:

$u_{f,t}$ is the deviation of firm f's continuously compounded return on day t of the test period from the mean of firm f's continuously compounded daily returns during the 201-day estimation period from $t=-300$ to $t=-100$;[19] and
L is the earlier of +40 or the last day of trading of the target's stock before merger consummation.

Since the accumulation period for *CAR* only extends to 40 days after the announcement date, differences between *DPREM* and *CAR* depend mainly on the probability that the market attaches to a successful acquisition and to the probability of competing bids (Niden 1988). Bid premia estimates based on target abnormal returns around the announcement date may be noisy because of the relatively long time between the announcement date and merger consummation. The median time between announcement and consummation for the 95 acquisitions in the sample is 130 calendar days. The pooling (124 days) and purchase (138 days) subgroups were not significantly different on this dimension, so this measurement problem is not expected to cause a systematic bias in the estimates of the effect of accounting method on bid premia. Differences between *DPREM* and *CAR* may also result from measurement error or misspecification of the returns generating model.[20] However, measurement problems are not expected to systematically differ between the purchase and pooling groups.

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[18] In the 13 cases which financed the acquisition with preferred stock, all but one involved newly issued preferred stock.

[19] Periods of non-trading were converted into daily returns assuming continuous compounding over the non-trading period.

Descriptive Statistics for Premia and Control Variables

After controlling (through the sampling procedure) for method of payment, tax treatment, and percentage of target stock acquired, Table 3 shows descriptive statistics for the three bid premia estimates classified by method of accounting for the acquisition.[21] Overall, target firms experienced large positive abnormal returns over the test period which is consistent with the results of prior research summarized in Jensen and Ruback (1983). Differences in bid premia between purchase and pooling groups are significant at .05 for *DPREM* and *CAR* and at .10 for *IPREM* as measured by a *t*-statistic for differences in means.

The Table 3 evidence of an association between method of accounting and premia paid for target shares does not rule out the possibility that the accounting method and bid premia are jointly determined. To investigate this possibility, control variables are operationalized below as target liquidity (*ZLQ*), target leverage (*ZLV*), target preannouncement market-to-book value (*ZMB*), relative size of target to bidder (*RS*), and the bidder's preannouncement (initial) holdings of target stock (*IH*). Specifically:

ZLQ is the target's quick assets (cash + receivables + marketable securities) divided by the market value of the target's common stock outstanding at $t = -40$;
ZLV is the book value of the target's long-term debt divided by the market value of the target's common stock outstanding as of the last balance sheet date before the acquisition;
ZMB is the market price per share of the target's common stock 40 trading days before the announcement date divided by the book value per share of the target's stock as of the last balance sheet date before the acquisition;
RS is the market value of the target's common equity at $t = -40$ divided by

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[20] Tests were also conducted using a market-adjusted returns model and results were essentially the same as those reported in the text and tables.

[21] Estimates of premia based on abnormal returns are smaller because they are based on continuously compounded returns, whereas *DPREM* and *IPREM* are based on simple return measurements.

Table 3
Estimates of Bid Premia and Target Abnormal Returns by Accounting Method (1972–1982)

	n[a]	*Mean*[b]	*Std. Dev.*	*Minimum*	*Median*	*Maximum*
Direct estimates of premia (*DPREM*):						
Poolings	59	0.641	0.41	−0.145	0.614	1.834
Purchases	22	0.419	0.49	−0.781	0.400	1.351
Tests of differences:						
t-statistic		1.75**				
Z-statistic[c]					1.75**	
Indirect estimates of premia (*IPREM*):						
Poolings	59	0.574	0.45	−0.138	0.473	2.028
Purchases	36	0.444	0.57	−.456	0.358	2.882
Tests of differences:						
t-statistic		1.41*				
Z-statistic[c]					1.48*	
Estimates of target cumulative abnormal returns (*CAR*):						
Poolings	59	0.282	0.27	−0.449	0.306	0.792
Purchases	36	0.170	0.28	−0.494	0.203	0.818
Tests of differences:						
t-statistic		1.88**				
Z-statistic[c]					2.05**	

Notation: See Figure 1 for definitions of *DPREM*, *IPREM*, and *CAR*.

* Significant at .10 (one-tailed test).

** Significant at .05 (one-tailed test).

[a] Direct estimates of premia (*DPREM*) were only possible in 22 of the 36 acquisitions accounted for as purchases. Preferred stock was the medium of exchange in 13 of the other 14 cases.

[b] The unit of measurement is a rate of return.

[c] The *Z*-statistic is a *Z* from the nonparametric Wilcoxon Rank Sum Test.

the market value of the bidder's common equity on the announcement date; and

IH is the percentage of the target's common stock held by the bidder at the announcement date.

Variables labeled with *Z* as the first letter are adjusted for industry by computing *Z*-scores based on COMPUSTAT firms in the same two-digit industry as the target firm. For example, the *Z*-score for firm *f*'s leverage is derived as:

$$ZLV_f=(LV_f-LV)/s(LV) \tag{4}$$

where:

LV is the mean of the leverage variable (as defined above) for all firms in the target's two-digit SIC code on COMPUSTAT in the last full year of firm *f*'s activity as an independent entity, and

$s(LV)$ is the standard deviation of the leverage variable (as defined above) for all firms in the target's two-digit SIC code on COMPUSTAT in the last full year of firm f's activity as an independent entity.

Table 4 shows summary statistics by accounting method for each of the control variables.[22] Three of the control variables are significantly correlated with accounting method. Relative to the mergers accounted for as purchases, the poolings in this sample involve less liquid targets with higher ratios of market-to-book value of equity. The poolings also involve bidders with relatively less preannouncement holdings of target stock.

As noted earlier, prior research demonstrates that the greater the target's differential, the more likely a stock-for-stock acquisition will be accounted for as a pooling. Therefore, it is not surprising to find in Table 4 that pooled targets have greater ratios of market-to-book value (*ZMB*) than targets acquired in mergers accounted for as purchases. Prior research also indicates that this ratio is negatively correlated with bid premia and may proxy for target management efficiency. Thus, the evidence in Table 4 that *ZMB* is smaller in the purchase group may work against the finding of higher bid premia for the mergers accounted for as poolings.

The association of preannouncement holdings (*IH*) with accounting method also comes as no surprise, because pooling is precluded in acquisitions where initial holdings are greater than ten percent. Since prior research on the relation between initial holdings and bid premia is mixed, it is unclear whether the association of *IH* and accounting method worked toward or against finding higher premia for poolings in this sample. In Table 4, target liquidity (*ZLQ*) is less in the pooling group. The finance research reviewed above suggests a direct relation between target liquidity and bid premia. Thus, the relation between *ZLQ* and accounting method in this sample works against the finding that bid premia for poolings are higher.

III. Empirical Tests and Results

Covariance Analysis

Covariance analysis is used to investigate the relation between acquisition accounting method and bid premia while controlling for the potentially intervening variables described above. The dependent variables of the regressions are the bid premia estimates described in Table 3. The experimental independent variable is an indicator variable, *AM*, set equal to one when the merger is accounted for as a pooling and zero when the merger is a purchase. The bid premia estimates are separately regressed on the experimental variable and five control variables as defined by equation (5) below. Under each variable is the expected sign of the regression coefficient.

$$\begin{array}{l} DPREM_j \\ IPREM_j = \alpha_j + \beta_1 AM_j + \beta_2 ZLQ_j + \beta_3 ZLV_j + \beta_4 ZMB_j + \beta_5 RS_j + \beta_6 IH_j + uj \\ CAR_j \qquad\quad + \qquad\quad + \qquad\quad - \qquad\quad - \qquad\quad - \qquad\quad ? \end{array} \tag{5}$$

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[22] Three of the 95 sample observations are outliers and are excluded from Table 4 and all further analysis in the paper. In each of the three cases at least one of the relative to industry Z-scores was more than five standard deviations away from the industry mean.

Table 4
Summary Statistics for Covariates by Accounting Method (1972–1982)

	n[a]	*Mean*	*Std. Dev.*	*Minimum*	*Median*	*Maximum*
Target liquidity (*ZLQ*):						
Poolings	58	−0.250	0.809	−1.801	−0.459	3.160
Purchases	34	0.138	0.928	−0.787	−0.162	4.246
Tests of differences:[b]		−2.97*			−2.97*	
Target leverage (*ZLV*):						
Poolings	58	0.013	0.794	−1.202	−0.103	4.027
Purchases	34	0.270	1.215	−1.095	−0.131	4.796
Tests of differences:[b]		−0.33			0.33	
Target market to book (*ZMB*):						
Poolings	58	0.275	0.729	−0.971	0.139	2.979
Purchases	34	−0.037	0.901	−1.409	−0.098	3.436
Tests of differences:[b]		2.29*			2.33*	
Relative size target to bidder (*RS*):						
Poolings	58	0.218	0.346	0.004	0.112	2.125
Purchases	34	0.225	0.275	0.014	0.136	1.165
Tests of differences:[b]		−0.37			−0.38	
Initial holdings (*IH*):						
Poolings	58	0.004	0.017	0.000	0.000	0.090
Purchases	34	0.069	0.147	0.000	0.000	0.470
Tests of differences:[b]		−2.41*			−2.43*	

Notation: Variables labeled with *Z* as the first letter are industry-adjusted. The *Z*-scores were computed based on the COMPUSTAT firms in the same two-digit industry as the target firm as defined by equation (4) in the text.

ZLQ is the target's quick assets (cash + receivables + marketable securities) divided by the market value of the target's common stock outstanding at $t = -40$;

ZLV is the book value of the target's long-term debt divided by the market value of the target's common stock outstanding as of the last balance sheet date before the acquisition;

TABLE 4—*Continued*

ZMB is the market price per share of the target's common stock 40 trading days before the announcement date divided by the book value per share of the target's stock as of the last balance sheet date before the acquisition;

RS is the market value of the target's common equity at $t = -40$ divided by the market value of the bidder's common equity on the announcement date; and

IH is the percentage of the target's common stock held by the bidder at the announcement date.

[*] Significant at .05 (one-tailed test).

[a] Three outliers, defined as observations with relative to industry variables more than five standard deviations from the industry mean are excluded.

[b] Tests for differences were conducted with *t*-statistics for differences in the location of the mean and with *Z*-statistics (nonparametric Wilcoxon Rank Sum Test) for differences in the median.

where:

AM_j is one if the accounting method is a pooling and zero if it is a purchase, and all other variables are as defined in Table 4.

Table 5 presents the results of the regressions. With *DPREM* (the direct estimate of bid premia) as the dependent variable, the estimated relation with target liquidity (*ZLQ*), target leverage (*ZLV*), target preacquisition ratio of market-to-book value of equity (*ZMB*), and relative target size (*RS*) is in the expected direction. The regression in Table 5 estimates that bid premia are higher for more liquid, less levered, relatively smaller targets with relatively lower market-to-book value ratios. Only the relative size variable is statistically significant at .05. The sign of the coefficient on the initial holdings variable is positive, but not significant. With these control variables in the regression, the coefficient on the accounting method indicator variable (significant at .03) suggests that bid premia are higher for acquisitions accounted for as poolings.

The results in Table 5 with *IPREM* as the dependent variable are consistent with those for *DPREM*, except that the significance level of the accounting method indicator variable is only 11 percent. With *CAR* as the dependent variable, the accounting method indicator is significant at .05. The *CAR* results in Table 5 differ from those reported for *DPREM* and *IPREM* in that *RS* is not significant, *ZLV* is not in the predicted direction, and the sign of the coefficient on the initial holdings variable is negative and marginally significant. The contradictory results on the initial holdings variable may indicate that the market attaches a lower probability to bid premia enhancing competition or management resistance when the bidder has a toehold at the announcement date.[23] Except for the positive (but insignificant) sign on *ZLV* in the regression on *CAR*, the estimated coefficients for the control variables are consistent with the discussion of variables suggested by the finance literature to influence bid premia.

Analysis of Purchase Acquisitions and a Matched Pair Test

Table 6 presents a breakdown of the sample by accounting method and, for the purchase group, by the APBO No. 16 criterion that apparently caused the purchase treatment.[24] These criteria may reflect opportunity costs of using the pooling method avoided by firms in the purchase group. The costs of complying with the criteria may vary across bidder-target combinations depending on the circumstances of each merger. To the extent that these differential costs are not controlled, differences in bid premia between the purchase and pooling groups are likely to systematically differ for reasons other than accounting effects. The

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[23] There were ten tender offers in the sample, seven poolings and three purchases. Regressions were also estimated omitting these observations and virtually identical results were obtained.

[24] Bidders are not required to report the reason they use the purchase method. To estimate the APBO No. 16 criterion violated for each purchase, the following sources were consulted: *WSJ* articles describing the acquisition; bidder and target annual reports for the period from two years before the acquisition announcement date to two years after the consummation date; target's proxy statement calling for a stockholder vote on the proposed merger; SEC filings connected with the acquisition (including prospectuses and forms 8K, 13D, 14D, and 14D-9), and *Moody's Investment Manuals*.

Table 5

Results of Regressions on Target Premia (1972–1982)

$$\begin{matrix} DPREM_j \\ IPREM_j \\ CAR_j \end{matrix} = \alpha_j + \beta_1 AM_j + \beta_2 ZLQ_j + \beta_3 ZLV_j + \beta_4 ZMB_j + \beta_5 RS_j + \beta_6 IH_j + u_j$$

Coefficients and Hypothesized Directions
(*t-statistics*)

Dependent Variable	α	β_1 +	β_2 +	β_3 −	β_4 −	β_5 −	β_6 ?	n[a]	R^2
DPREM	0.53 (5.17)*	0.22 (1.86)*	0.06 (0.91)	−0.06 (−1.16)	−0.06 (−0.92)	−0.30 (−2.08)*	0.30 (0.53)	79	0.146
IPREM	0.54 (5.47)*	0.15 (1.23)	0.08 (1.25)	−0.07 (−1.05)	−0.02 (−0.31)	−0.39 (−2.34)*	0.32 (0.54)	92	0.098
CAR	0.21 (3.87)*	0.11 (1.71)*	0.02 (0.69)	0.02 (0.68)	0.00 (−0.11)	−0.05 (−0.59)	−0.52 (−1.63)	92	0.096

Notation: AM_j is an indicator variable which equals one for poolings and zero otherwise. See Figure 1 for definitions of *DPREM*, *IPREM*, and *CAR*, and covariates are defined in Table 4.

* Significant at .05 (one-tailed test).

[a] All three regressions exclude three outlier observations (see Table 4). The regression on *DPREM* also excludes the preferred stock acquisitions.

Table 6
Description of Final Sample of Purchases by APBO No. 16 Criterion Violated (1972–1982)

Criterion Number	n	*Abbreviated Description of Criterion*
1	1	Neither company controlled by another within two years before initiation of the transaction.
2	7	No more than ten percent intercorporate (between the combining companies) investments in voting common stock prior to initiation of combination.
3	1	Transaction takes less than one year to consummate unless unavoidable delay (e.g., due to antitrust proceedings).
4	13[a]	Exchange of common voting stock for 90 percent of target voting stock.
6	3	No treasury stock related to transaction.
9		Combination is resolved at date of consummation (i.e., no contingencies).
9a	2	Contingent purchase price depending on resolution of uncertainty involving potential losses of target.
9b	2	Contingent payout to target management depending on consummation of merger.
9c	2[a,b]	Contingent purchase price depending on market value of bidder's stock during specified time period after the combination's effective date.
12	2[b]	No divestiture of target assets after transaction.
Unknown	3	Could not determine criterion that made combination a purchase.
	36	All purchases
	59[a]	All poolings
	95	All acquisitions in sample

[a] Includes one outlier excluded from statistical analysis.

[b] One of the transactions accounted for as a purchase violated two of the 12 criteria—numbers 9b and 12. It is included under criterion 12 because that violation appeared to be more important economically.

regression described above attempted to alleviate this problem by including control variables related to bid premia and to the 12 APBO No. 16 criteria. This section selects for further analysis the single criterion most commonly violated by the sample firms in the purchase group. A matched pair test is used to more directly control for differential costs between mergers in the purchase and pooling groups that may be related to that criterion most frequently violated by the sample firms.

The largest subcategory of purchases in Table 6 were accounted for as purchases because the bidders exchanged preferred (as opposed to voting common) stock to finance the acquisitions. The choice of preferred versus common stock in an equity-financed acquisition may indicate reluctance to dilute control

Table 7
Relative Size (*RS*) and Bid Premia Comparisons
Purchases Financed with Preferred Stock
Versus All Purchases and All Poolings
(1972–1982)

		Means			*Medians*		
Sample Subgroup	n[a]	IPREM	CAR	RS	IPREM	CAR	RS
Purchases financed by the issue of preferred stock	12	0.28	0.11	0.34	0.25	0.08	0.23
All purchases	34	0.47	0.17	0.22	0.39	0.20	0.14
All poolings	58	0.58	0.29	0.22	0.47	0.31	0.11

[a] Excludes three outliers (see Table 4).

of the bidding firm. This reluctance to exchange voting stock could depend on the size of the target relative to the size of the bidder. Since relative size is inversely correlated with bid premia, the acquisitions in this subcategory may have lower bid premia estimates, not because of the accounting method, but because the targets are relatively larger than targets in mergers accounted for as poolings.

Table 7 presents the mean and median relative size and the bid premia estimates, *IPREM* and *CAR*, for purchases financed by the issue of preferred stock as compared to all purchases and to all poolings. The targets acquired by the exchange of bidder preferred stock for target common stock are relatively larger as compared to other purchases and to poolings. Consistent with prior research, the estimated relation of relative size with all three bid premia estimates was negative in the regression analyses (and significant in two of the regressions). This suggests an alternative explanation for the higher bid premia estimates observed (in Table 7) for poolings than for preferred stock purchases.

To provide evidence that may distinguish between the alternative explanations, each preferred stock purchase acquisition was matched with a pooling acquisition closest on the relative size dimension. Table 8, panel A, lists each of the 12 preferred stock acquisitions with the bid premia estimates, *IPREM* and *CAR*, and the amounts associated with each of the control variables, while panel B shows the corresponding variables for each of the matched pooling acquisitions. The 12 targets accounted for as purchases in Table 8 are relatively less levered, more liquid, and generally had lower preacquisition market-to-book value of equity ratios than the 12 matched (on relative size) poolings. However, in all cases these differences work against the finding of higher premia for the poolings in this sample.

The mean target *CAR* for the 12 preferred stock purchases in Table 8 is .11 (median, .08) compared to .37 (median, .41) for the 12 matched poolings, a difference significant at .01 using either a parametric *t*-test or a nonparametric Wilcoxon Rank Sum Test. The mean bid premia estimate, *IPREM*, for the 12 pur-

Table 8
Preferred Stock Purchases and a Matched (on Relative Size of Target to Bidder) Subsample of Poolings (1972–1982)

Announcement Date	IPREM	CAR	RS	ZLV	ZMB	ZLQ	IH
Panel A. Purchases:							
6/23/81	−0.30	0.11	0.01	0.20	0.08	0.07	0.00
5/25/76	0.13	0.20	0.04	−0.59	−1.02	−0.19	0.00
9/20/76	1.04	0.41	0.04	−0.64	−0.26	−0.21	0.00
6/20/78	0.71	0.27	0.14	−0.33	0.06	−0.21	0.00
2/2/77	0.14	0.00	0.21	0.23	0.05	−0.15	0.00
11/21/77	0.34	0.22	0.21	−1.09	0.57	−0.56	0.00
1/9/80	0.12	−0.23	0.25	0.71	0.53	1.55	0.00
6/18/82	−0.11	0.00	0.52	−0.60	−0.88	−0.55	0.00
6/16/81	0.37	0.04	0.53	−0.17	−0.18	−0.54	0.00
11/7/77	0.32	0.27	0.62	2.73	−1.41	4.25	0.00
11/28/75	0.40	0.06	0.64	0.08	−0.04	−0.57	0.00
11/10/81	0.18	0.02	0.89	−0.29	−0.05	0.22	0.00
Means	0.28	0.11	0.34	0.02	−0.21	0.26	0.00
Medians	0.25	0.08	0.23	−0.23	−0.05	−0.20	0.00
Panel B. Poolings Matched on RS:							
2/13/79	0.44	0.12	0.01	0.56	−0.27	−0.25	0.00
11/11/75	2.03	0.70	0.04	−0.27	−0.17	−0.81	0.00
12/7/79	1.01	0.78	0.04	0.39	0.70	−0.90	0.00
10/14/80	0.35	−0.12	0.15	0.07	−0.11	−0.42	0.00
11/25/81	0.73	0.50	0.21	0.16	0.94	−0.52	0.00
9/3/76	0.50	0.39	0.21	0.02	0.72	−0.74	0.00
7/23/80	1.66	0.66	0.25	0.33	−0.12	−0.11	0.00
3/2/81	−0.01	0.20	0.42	−0.71	0.26	−0.28	0.07
7/11/74	−0.14	0.43	0.44	−0.05	0.31	−0.56	0.00
11/11/77	1.03	0.25	0.60	0.30	−0.36	0.67	0.00
2/20/80	−0.06	0.49	0.75	2.08	−0.09	1.51	0.00
6/6/80	0.20	0.10	0.84	−0.13	−0.07	−0.53	0.00
Means	0.65	0.37	0.33	0.23	0.14	−0.25	0.01
Medians	0.47	0.41	0.23	0.11	−0.08	−0.47	0.00
Tests for differences:							
t-statistic	−1.65*	−2.82**	0.10	−0.61	−1.67*	1.13	
Z-statistic[a]	−1.49*	−2.27**	1.10	−1.33*	−1.57*	1.88**	

* Significant at .10 (one-tailed test).

** Significant at .05 (one-tailed test).

[a] Nonparametric Wilcoxon Rank Sum Test for paired observations.

chases in Table 8 is .28 (median, .25) compared to .65 (median, .47) for the matched poolings. These differences are consistent with the differences in *CAR*s between the two groups, but only significant at the .06 (*t*-test) or .07 (Wilcoxon test).

The relatively large differences in bid premia estimates may be due to omitted intervening variables that jointly determine bid premia and accounting method. On the other hand, while it is difficult to attribute all of the observed differences to benefits from accounting method, their existence may indicate that there were greater benefits derived from accounting effects for the 12 bidders in the pooling group. The observed association between bid premia and accounting method may result from the willingness of bidders to pay for such benefits. Relative size was held constant between the two groups and the identified intervening variables in this test worked against the finding of higher bid premia for the poolings. The differences in bid premia may indicate that benefits derived from the accounting method outweighed the opportunity cost associated with the dilution of control due to the use of common stock for the 12 bidders in the pooling group.

IV. Conclusion

The empirical relation between acquisition accounting method and bid premia is difficult to assess. Benefits associated with accounting method are difficult to isolate, difficult to measure, and some may be obtained with either the purchase or the pooling method. However, an asymmetry in the costs of qualifying for the purchase and pooling treatments supports the argument in this study that bidders who use the pooling method are more likely to be using that method because of benefits associated with accounting method than bidders who use the purchase method. Therefore, the average benefits derived from accounting method are expected to be greater for acquisitions accounted for as poolings.

The regression results indicate that in this sample the acquisitions accounted for as poolings involved higher average bid premia than the acquisitions accounted for as purchases. To the extent that the efforts to identify and control intervening variables were successful, these results are consistent with the explanation that the higher bid premia for the mergers accounted for as poolings reflect an additional amount that bidders are willing to pay for benefits derived from accounting method. The comparison of bid premia for 12 acquisitions accounted for as purchases because of the use of preferred stock and 12 poolings matched on relative target-to-bidder size is consistent with the regression results.

The evidence in this study suggests that benefits derived from acquisition accounting method may command a price in the market for corporate control. However, a competing explanation for an association between bid premia and acquisition accounting method is that higher bid premia lead to a higher probability of pooling. The efforts here to control for bid premia determinants (unrelated to accounting effects) mitigate but do not eliminate this identification problem.

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The Relation Between Stock Returns and Accounting Earnings Given Alternative Information

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ABSTRACT: This paper examines the relation between stock returns and accounting earnings under the assumption that the market observes current-period information other than earnings. This assumption is motivated by existing empirical evidence that stock returns lead accounting earnings. The analysis shows that the returns-earnings relation depends on the relative ability of earnings versus alternative information to predict future earnings as well as the time-series persistence of earnings. Assuming that the researcher does not observe the alternative information, the earnings response coefficient should be increasing both in the ability of past earnings to predict future earnings and in earnings persistence. The variance of stock price changes during the announcement of earnings should be decreasing in predictability and increasing in persistence. Empirical tests of these four hypotheses are generally consistent with the theory. Also discussed is how the assumption of alternative information may be useful in examining the information environment hypothesis, in assessing *ad hoc* methods of reducing measurement error bias, and in formulating how economic earnings differ from accounting earnings.

THIS study investigates the relation between stock returns and accounting earnings under the assumption that the market observes current-period information other than earnings that is useful in predicting future earnings.

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Beginning with the seminal work by Ball and Brown (1968), the returns-earnings relation has been the focus of many studies. As the literature has progressed, researchers have used finance theories to make empirical predictions. For example, Kormendi and Lipe (1987) model stock returns as a function of the revisions in expectations of earnings, assume that earnings can be represented by a univariate time-series process, and then show that the time-series properties of earnings will be an important factor in the returns-earnings relation. Other studies also use explicit theoretical models (Beaver et al. 1980; Beaver et al. 1987; Collins and Kothari 1989; Easton and Zmijewski 1989; Imhoff and Lobo 1988; Lipe 1986). The goal of this area of research is to increase understanding of how earnings and other accounting information are related to stock prices.

This paper's focus on alternative information is motivated by recent empirical evidence and theoretical models. Beaver et al. (1987), Collins et al. (1987), and Collins and Kothari (1989), among others, find that unexpected earnings from year $t+1$ (as measured by the researcher) are correlated with returns from year t. The implication is that the market obtains alternative information in year t which is a substitute for some of the "news" in earnings of year $t+1$. Further, Holthausen and Verrecchia (1988) use an information economics model to demonstrate that the relation between stock prices and a given source of information depends on the availability of other useful information.

In order to examine the role of information other than accounting earnings, I assume that during year t the market receives a noisy signal of earnings for year $t+1$. Combining this assumption with the model used in Kormendi and Lipe (1987), I show that the stock return reaction to earnings is a function of (1) the time-series properties of earnings, (2) the interest rate used to discount expected future earnings, and (3) the relative ability of earnings versus alternative information to predict future earnings. The third factor is the result of allowing the market (but not researchers) to observe alternative information.

Four testable hypotheses regarding the relations between stock prices and earnings are derived. The first two are that the coefficient which measures the stock return response to a one-dollar earnings shock (hereafter, the response coefficient) is an increasing function of both the "predictability of the earnings series" and the time-series persistence of earnings. The predictability of earnings is defined as the ability of past earnings to predict future earnings, and it is reflected in the variance of the shocks in the univariate earnings process (as the variance decreases, the predictability of earnings increases). As earnings predictability increases, the current earnings information becomes more useful in predicting future earnings and, therefore, the response coefficient increases. An alternative interpretation is that as earnings predictability increases, the difference between the univariate earnings shock and the market's assessment of unexpected earnings decreases and, therefore, the downward bias in the response coefficient decreases. The difference between predictability and persistence is that the predictability of earnings is a function of the average absolute magnitude of the annual earnings shocks, whereas the time-series persistence of earnings reflects the autocorrelation in earnings.

The other two hypotheses are that the variance of stock price changes during the release of earnings is negatively related to earnings predictability and positively related to earnings persistence. Holthausen and Verrecchia (1988) and Beaver (1968), among others, analyze the variance of price changes when information is announced. The negative effect of predictability occurs because the variance of price changes measures the return reaction to the typical earnings shock. As the predictability of earnings increases, the absolute magnitude of the earnings shock will probably be smaller, leading to a lower variance of price changes despite the fact that as predictability increases, a given earnings shock is worth more (the response coefficient is larger). The effect of persistence is positive because the greater persistence means a larger reaction to the typical earnings shock.

The four hypotheses are empirically tested using the sample firms from Kormendi and Lipe (1987). The parameters of interest (the response coefficient, variance of price changes, and predictability and persistence of earnings) are estimated for each of 145 firms. Simple and partial rank correlations show that the response coefficient is positively related to both predictability and persistence across firms. The variance of price changes is negatively related to predictability, but the positive relation with persistence is very weak. Sensitivity analyses suggest that the results are not due to ignoring cross-firm differences in risk or size. However, errors in measuring the univariate earnings shocks may cause overstated significance levels.

The rest of the paper is organized as follows. The theoretical relation between returns and earnings is developed and discussed in Section I, with the mathematical details presented in the Appendix. Section II presents the empirical tests. Section III discusses other insights gained from a theoretical model that assumes that the market has alternative information. Section IV summarizes and concludes the paper.

I. Theory

The relations between stock prices, accounting earnings, and alternative information are represented by the following three equations:

$$R_t = f(R_t^e, X_t, I_t, X_{t-1}, I_{t-1}, X_{t-2}, I_{t-2}, \ldots), \tag{1}$$

$$\Delta X_t = \sum_{i=1}^{N} b_i \Delta X_{t-i} + e_t, \text{ and} \tag{2}$$

$$I_t = X_{t+1} + n_{t+1}. \tag{3}$$

In equation (1), the return on a share of common stock, R_t, is a function of some exogenous expected return, R_t^e, and the unexpected return due to the release of accounting earnings, X_t, and the alternative information, I_t. Lags of X_t and I_t are included in equation (1) because they may be useful in determining the unanticipated information.

Three assumptions are imposed on equation (1): stock price equals the present value of expected future dividends; the discount rate, β, is constant over time; and the present value of the revisions in expectations of future dividends equals the present value of the revisions in expectations of future earnings. Together, these assumptions imply that the unexpected stock return in period t, R_t^u, equals the present value of the revisions in expectations of current and future earnings. The first and second assumptions are commonly used in finance and accounting studies. Ohlson (1988) shows that the two represent special cases of a more general model based on state dependent dividends and a no arbitrage equilibrium. The third assumption can be thought of as an extreme version of the statement, "accounting earnings provide information about the future dividend paying ability of the firm." While this is a stringent assumption, some link between earnings and dividends is necessary in order to derive a relation between returns and earnings. For example, Ohlson links earnings and dividends by assuming that both are driven by the same underlying events or states of nature. The model could be based on less restrictive valuation assumptions, but these three are chosen in order to clearly demonstrate the effect of alternative information.[1]

Equations (2) and (3) specify the information structure of the model. Equation (2) describes the univariate characteristics of earnings. The b_i are the autoregressive coefficients, and e_t is the serially uncorrelated earnings shock in period t. Kormendi and Lipe (1987) demonstrate that larger b_i coefficients cause the current-period earnings shock to have a larger impact on future earnings (greater persistence). The "predictability of the earnings series" is captured by the variance of the earnings shocks, σ_e^2. If $\sigma_e^2=0$, then past earnings predict future earnings perfectly. The ability of past earnings to predict future earnings decreases as σ_e^2 increases. Note that the predictability and the persistence of the earnings series are distinct concepts. Persistence describes the time-series relation between the current-period earnings shock and future earnings. Predictability reflects the variation in the earnings shocks. One can imagine a random-walk and a white-noise series which have the same variance of shocks. The former has much more persistence, but the two are equally predictable (the forecast errors have the same variance). Alternatively, one can imagine two random-walk series with high and low variance of shocks, respectively. The former is less predictable, but the two have equal persistence.[2]

Equation (3) shows that the alternative information equals next period's earnings plus noise, n_{t+1}. The noise is assumed to be serially uncorrelated and is uncorrelated with e_{t+k}, for all k. In the spirit of Holthausen and Verrecchia (1988), investors have useful information other than current-period earnings.[3] The alternative information could encompass production/investment decisions or analysts' forecasts of X_{t+1} made at t. Alternatively, since X_t and I_t are the only sources of new information, one could think of I_t as representing all information other than current and past accounting earnings. Since the empirical tests use of annual data, I_t and X_t are assumed to be observed simultaneously in year t.[4]

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[1] These are essentially the same assumptions used in Kormendi and Lipe (1987), and using them provides some continuity. In addition, Ohlson (1988, 42) states that, ". . . useful empirical studies can be conceived even when the concepts of what determine security value are unspecified or under-identified, or when the study maintains hypotheses that do not derive from more primitive assumptions."

[2] The economic determinants of the persistence or the predictability of earnings are not investigated in this paper. Instead, the theory shows that these two parameters are potentially important, and empirical evidence suggests that they are important. Given the results, an economic analysis of the parameters appears useful. For example, Lev (1983) provides some intuition regarding the autocorrelation of earnings and the variability of earnings shocks.

[3] Other studies have modeled some forms of alternative information. One approach is to decompose earnings and show how the components can provide more information than earnings alone (Lipe 1986; Rayburn 1986; Wilson 1986; among others). In most of these models, assessments of expected future earnings do not involve trade-offs between the components and, therefore, earnings predictability is not a factor. Another approach is to include both accounting earnings and

The appendix transforms these assumptions into a model of returns as follows:

$$R_t^* = (1+PVR)\frac{[e_t - Mw_t + \beta M w_{t+1}]}{P_{t-1}}. \tag{4}$$

The term in brackets reflects the new information revealed in year t. The unexpected information regarding the current-period earnings shock equals $e_t - Mw_t$. In year t, the market observes X_t and infers e_t. But a portion of e_t was anticipated in year $t-1$. Specifically, by observing X_{t-1} and I_{t-1}, the market infers $w_t = e_t + n_t$. The expectation of e_t in year $t-1$ is Mw_t, where:

$$M = \frac{\sigma_e^2}{\sigma_e^2 + \sigma_n^2}.$$

The other new information concerns next year's earnings. By observing X_t and I_t, the market infers w_{t+1}. The expectation of e_{t+1} in year t is Mw_{t+1}. Prior to year t, the expected value of e_{t+1} is zero. Thus, the new information about e_{t+1} equals Mw_{t+1}. This is multiplied by the discount rate in order to obtain the present value of the revision in the expectation of X_{t+1}. PVR is the persistence of the earnings series. If the univariate earnings series were white noise, then $PVR = 0$ and equation (4) would only contain the bracketed term divided by price. But if the time-series coefficients differ from white noise, then the new information in X_t and I_t will affect the expectations of earnings in periods beyond $t+1$. In other words, the new information persists into the future, and PVR captures this persistence. P_{t-1} is the stock price at the end of year $t-1$.

Equation (4) presents the theoretical relation between returns and earnings. Before the hypotheses can be developed, some estimation issues must be resolved. If researchers observe I_t, then they can use the market's assessment of unexpected current-period earnings, $e_t - Mw_t$, as the independent variable in esti-

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"permanent" earnings in the model (Beaver et al. 1980; Beaver et al. 1987). The typical assumption is that accounting earnings equals the market's perception of permanent earnings plus noise. In this case, permanent earnings appear to be known or knowable without reference to accounting earnings and, therefore, the latter do not play a role in the valuation of securities. In contrast, under the Holthausen and Verrecchia (1988) assumptions and the assumptions discussed above, the market revises expectations of future dividends based on accounting earnings and alternative information.

[4] As with the valuation assumptions, there are alternative ways to structure equations (2) and (3). For example, I_t could be a vector of information. Also, there could be interactions between X_t and I_t by assuming that e_t and n_t are cross-correlated or that I_{t-1} (X_{t-1}) affects X_t (I_t). If one used a shorter cumulation period for stock returns, then the release of I_t and X_t would be sequential instead of simultaneous, as discussed in the Appendix. The exact effect of changing the assumptions would depend on what new assumptions were made.

mating the reponse coefficient as follows:

$$R_t=k_1'+a_0'\frac{e_t-Mw_t}{P_{t-1}}+a_1'\frac{Mw_{t+1}}{P_{t-1}}+UR_t'. \tag{5}$$

But in order to be consistent with previous papers, I estimate the empirical relation using only returns and earnings data as follows:[5]

$$\begin{aligned} R_t&=k_1+a_0\frac{e_t}{P_{t-1}}+UR_t,\\ &=\bar{R}^*+(1+PVR)(1-M)\frac{e_t}{P_{t-1}}\\ &\quad+\left(R_t^*-\bar{R}^*+(1+PVR)\frac{[\beta Mw_{t+1}-Mn_t]}{P_{t-1}}\right). \end{aligned} \tag{6}$$

In equation (6), a_0 is the response coefficient, $\bar{R}^*$ is the average expected return over time, and UR_t consists of n_t, n_{t+1}, e_{t+1}, and any intertemporal variation in expected returns. Note that UR_t and e_t are independent. Therefore, UR_t represents uncorrelated noise.

Using equation (6) instead of equation (5) implicitly assumes that researchers observe R_t and e_t but not I_t. Alternatively, researchers observe nonearnings information but choose to ignore it. Thus, the focus of this paper is on how the existence of alternative information which is not used by researchers affects the observed relation between returns and earnings. The tasks of identifying alternative sources of information and incorporating them into the empirical tests are left to future research. Results in Ou and Penman (1989) suggest that such efforts can be successful.

In equation (6), $a_0=(1+PVR)(1-M)$. According to the Kormendi and Lipe model, $a_0=(1+PVR)$. The difference is due to including I_t in this paper. Note that $0\leq M\leq 1$ which implies that $a_0\leq(1+PVR)$. Consider the two extreme cases of $M=0$ and $M=1$. First, suppose that I_t is not useful in predicting X_{t+1} because $\sigma_n^2=\infty$ (or I_t is all noise). As $\sigma_n^2\rightarrow\infty, M\rightarrow 0$, in which case Kormendi and Lipe and equation (6) yield the same theoretical value for a_0. This occurs because the difference between the models is the inclusion of I_t; but if I_t is so noisy that it provides no information, then the models are the same. Second, suppose that $\sigma_n^2=0$, in which case I_t predicts X_{t+1} without error. In this case, $M=1$ and $a_0=0$; the return reaction to the earnings shock is zero because current-period earnings are useless in predicting X_{t+1}, given I_t. Thus, Kormendi and Lipe's (1987) result is a special case of equation (6).

The result that a_0 is a function of $(1-M)$ can also be interpreted as an errors-in-variables bias. Since the only explicit information source in Kormendi and Lipe is earnings, e_t represents both the earnings shock and the market's assessment of unexpected earnings. In this paper, the latter equals e_t-Mw_t. If e_t-Mw_t

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[5] Some researchers estimate the response coefficient using reverse regression in order to avoid the bias in a_0 due to measurement errors. However, Section III shows that the reverse regression coefficients are also biased. Therefore, reverse regression is not used in this paper.

(deflated by price) is the independent variable as in equation (5), then $a_0' = (1 + PVR)$ which is consistent with the prediction of Kormendi and Lipe. But if the earnings shock is the independent variable as in equation (6), then there is measurement error which equals $e_t - (e_t - Mw_t) = Mw_t$. The well-known errors-in-variables result (Maddala 1977, 292–293) is that:[6]

$$a_0 = \frac{a_0'}{1 + \dfrac{\sigma^2(Mw_t)}{\sigma^2(e_t - Mw_t)}} = a_0'(1-M) = (1+PVR)(1-M).$$

Thus, the response coefficient estimated in equation (6) is a biased estimate of $(1+PVR)$, and $(1-M)$ represents the bias.

This discussion of measurement error is not intended to trivialize the role of the predictability of earnings in the relation between returns and earnings. By including I_t in the model, market participants have two competing sources of information to use in forming expectations of future earnings. The usefulness of each signal is determined by its relative ability to predict the future. Thus, R_t^u in equation (4) is a function of M (and, therefore, predictability) whether researchers use I_t to measure market expectations or not. The use or nonuse of I_t simply determines whether M appears in the independent variable in equation (5) or in the response coefficient in equation (6).

Hypotheses

The four hypotheses are now developed. Equation (6) shows that a_0 is a function of persistence and the relative variability of n_t and e_t. Differentiating a_0 with respect to σ_e^2 demonstrates the relation between the response coefficient and the predictability of the earnings series:

$$\frac{\partial a_0}{\partial \sigma_e^2} = -\frac{(1+PVR)\sigma_n^2}{(\sigma_e^2 + \sigma_n^2)^2} < 0. \tag{7}$$

Since σ_n^2 and σ_e^2 are positive, the derivative is negative as long as $PVR > -1$. If earnings are a white noise process, then $PVR = 0$. A negative PVR would mean that earnings are less persistent than white noise which, based on prior empirical results, is unlikely. Thus, the derivative is negative. As the predictability of the earnings series increases (or as σ_e^2 decreases), the response coefficient increases. To understand the positive relation, recall that in period $t-1$, the market's expectation of e_t equals:

$$Mw_t = \frac{\sigma_e^2}{(\sigma_e^2 + \sigma_n^2)}(e_t + n_t).$$

Decreasing σ_e^2 while holding σ_n^2 constant implies that less of e_t is anticipated. The decrease in σ_e^2 causes the market to rely less on the prior information and more on X_t. In other words, as predictability increases, X_t is more useful in assessing expectations of future earnings. Alternatively, the measurement error perspective suggests that a_0 is positively related to predictability because increasing earnings predictability reduces the variance of the measurement error which causes a decrease in the downward bias in a_0.

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[6] This assumes that deflating the dollar returns and the dollar earnings metrics by P_{t-1} does not affect the expected value of the coefficients.

Since $0 \leq M \leq 1$, equation (6) shows that a_0 is positively related to *PVR* except in the extreme case of $M=1$. An increase in the time-series persistence of earnings leads to an increase in the response coefficient.

An alternative method of analyzing the relation between stock prices and earnings is to examine the variance of price changes around earnings announcements. The change in price, ΔP_t, equals the stock return, R_t, multiplied by the beginning of period price, P_{t-1}.[7] Equation (4) implies that the variance of price changes equals:[8]

$$\mathrm{Var}(\Delta P_t)=\mathrm{Var}[R_t^u P_{t-1}]=(1+PVR)^2\left[\frac{\sigma_e^2(\beta^2\sigma_e^2+\sigma_n^2)}{\sigma_e^2+\sigma_n^2}\right]. \tag{8}$$

Note that $\mathrm{Var}(\Delta P_t)$ is not conditional on the information released in year t. It reflects the average squared change in price based on the mean and variance of the information system and not the price change in response to a given earnings shock. The relation between $\mathrm{Var}(\Delta P_t)$ and the predictability of the earnings series is assessed by differentiating equation (8) with respect to σ_e^2, or:

$$\frac{\partial \mathrm{Var}(\Delta P_t)}{\partial \sigma_e^2}=(1+PVR)^2\frac{\beta^2(\sigma_e^2)^2+2\beta^2\sigma_e^2\sigma_n^2+(\sigma_n^2)^2}{(\sigma_e^2+\sigma_n^2)^2}>0. \tag{9}$$

Since the derivative is positive, $\mathrm{Var}(\Delta P_t)$ is a decreasing function of the predictability of the earnings series, even though the response coefficient is an increasing function of predictability. Intuitively, if firm A's earnings shocks are less variable than firm B's, a one-dollar shock in each series would cause a much larger stock return for firm A. But on average, the absolute magnitude of the earnings shocks is smaller for firm A and, therefore, the average variation in the price of firm A is smaller. Thus, analyzing stock returns conditional on the fact that earnings are announced during the period is very different from analyzing

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[7] Actually, part of the return in period t may be in the form of a dividend and, therefore, R_tP_{t-1} may differ from ΔP_t. However, the former measure may be more appropriate for addressing the relation between stock prices and earnings; the price changes associated with the ex-dividend date are probably not a function of information released during the year. The empirical tests were also performed using $\mathrm{Var}(P_{jt}-P_{jt-1})$, and the results were similar.

[8] First, since the variance equals the actual minus expected price change squared, R_t^e does not appear in equation (8). Second, from equation (4), the change in price due to X_t and I_t is:

$$R_t^u P_{t-1}=(1+PVR)[e_t-Mw_t+\beta M w_{t+1}].$$

The variance of the change in price is then:

$$\begin{aligned}\mathrm{Var}[R_t^u P_{t-1}]&=(1+PVR)^2[(1-M)^2\sigma_e^2+M^2\sigma_n^2+\beta^2M^2\sigma_e^2+\beta^2M^2\sigma_n^2]\\&=(1+PVR)^2\frac{(\sigma_n^2)^2\sigma_e^2+(\sigma_e^2)^2\sigma_n^2+\beta^2(\sigma_e^2)^3+\beta^2(\sigma_e^2)^2\sigma_n^2}{(\sigma_e^2+\sigma_n^2)^2}\\&=(1+PVR)^2\frac{\sigma_e^2(\beta^2\sigma_e^2+\sigma_n^2)(\sigma_e^2+\sigma_n^2)}{(\sigma_e^2+\sigma_n^2)(\sigma_e^2+\sigma_n^2)}\end{aligned}$$

which yields equation (8).

returns conditional on the magnitude of the earnings shock. In particular, these two constructs have opposite relations with the predictability of the earnings series.[9]

A further examination of equation (8) reveals that Var(ΔP_t) is positively related to *PVR* (again assuming $PVR > -1$). Thus, whether the relation between stock prices and earnings is assessed using the response coefficient or the variance of price changes, the impact of persistence is predicted to be positive.

To summarize, the theory predicts that the response coefficient will be positively related to the persistence and the predictability of the earnings series. The unconditional variance of price changes is expected to be positively associated with persistence but negatively associated with predictability. These hypotheses are tested in the next section.

II. Empirical Results

Kormendi and Lipe (1987) estimate the relation between returns and earnings and test their proposition that a_0 should be related to *PVR*. This section uses their sample of firms to test whether a_0 is also related to the predictability of earnings. First, the Kormendi and Lipe data and results are discussed. Second, the impact of the predictability of earnings is examined. Third, some sensitivity analyses are conducted.

Kormendi and Lipe use a two-equation system to estimate both the response coefficient, a_0, and the time-series properties of earnings, b_i. Using the notation from Section I, they estimate the following:

$$R_{jt} = k_{1j} + a_{0j} \frac{e_{jt}}{P_{jt-1}} + UR_{jt} \tag{10}$$

$$\Delta X_{jt} = k_{2j} + b_{1j} \Delta X_{jt-1} + b_{2j} \Delta X_{jt-2} + e_{jt}. \tag{11}$$

The inclusion of the j subscripts indicates that a separate system is estimated for each firm, j. Also, the autoregressive model of earnings is limited to two lags. In order to reduce the cross-sectional correlation in the data, Kormendi and Lipe use firm-specific returns and earnings. R_{jt} are the residuals from an annual market model in which the percentage return for firm j's common stock in year t is regressed on the percentage change in the CRSP value-weighted market index. The annual returns are cumulated from April of year t until March of year $t+1$,

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[9] The negative relation between the predictability of earnings and Var(ΔP_t) may appear contrary to the Holthausen and Verrecchia (1988) information economics model. They derive a positive relation between the ability of an information source to predict the future liquidating dividend of the firm and Var(ΔP_t). The difference in signs is due to a difference in assumptions. In their model, the firm's value is a function of the liquidating dividend, u. If the ability of earnings to predict u increases, then the announcement of earnings provides more information. The present assumptions imply that the revisions in expectations of future accounting earnings are valued by the stock market. As mentioned above, as the predictability of the earnings series increases, the release of X_t and I_t contains less new information regarding future earnings and, therefore, Var(ΔP_t) decreases. Indeed, Holthausen and Verrecchia show that decreasing the variance of u leads to a decrease in Var(ΔP_t). Thus, the two models agree that as the variance of the attribute that is valued in the stock market decreases, Var(ΔP_t) decreases.

Table 1
Summary Statistics for Estimated Parameters[1]
($n=145$ Firms)

Model:

$$R_{jt}=k_{1j}+a_{0j}\frac{e_{jt}}{P_{jt-1}}+UR_{jt} \tag{10}$$

$$\Delta X_{jt}=k_{2j}+b_{1j}\Delta X_{jt-1}+b_{2j}\Delta X_{jt-2}+e_{jt} \tag{11}$$

Parameter	*Mean*	*Standard Deviation*	*Minimum*	*First Quartile*	*Median*	*Third Quartile*	*Maximum*
$\hat{a}_{0j}$	3.38	3.12	−2.28	1.41	2.50	5.07	17.98
$\widehat{PVR}_j$	8.93	3.41	4.36	6.92	7.91	10.12	22.71
$\hat{V}_{ej}$	.78	1.84	.00	.06	.17	.68	17.83
$\hat{V}_{\Delta Pj}$	45.58	86.69	2.33	13.20	23.11	43.32	774.4
$\hat{b}_{1j}$	−.08	.29	−.70	−.29	−.07	.12	.92
$\hat{b}_{2j}$	−.17	.24	−.79	−.31	−.19	−.06	.66
$\hat{\lambda}_j$	1.10	.34	.32	.87	1.09	1.28	2.09
$MEDVAL_j$	1239	3314	9.3	115	397	772	27695

[1] R_{jt}=the firm specific (real) percentage return for firm j in year t.
ΔX_{jt}=the firm specific change in (real) earnings.
P_{jt-1}=the (real) stock price for firm j at the beginning of year t.
e_{jt}=the shock in the univariate earnings series.
b_{ij}=the autoregressive coefficients.
a_{0j}=the response coefficient.
Other estimated parameters are as follows:
$\widehat{PVR}_j$=earnings persistence, derived from the estimated b_{ij}, assuming $r=10\%$.
$\hat{V}_{ej}$=variance of the estimated earnings shocks, $\hat{e}_{jt}$.
$\hat{V}_{\Delta Pj}$=variance of $R_{jt}\times P_{jt-1}$.
$\hat{\lambda}_j$=estimated beta from an annual market model regression.
$MEDVAL_j$=the median value of equity for each firm, j, in millions.

because sample firms all have December 31 year-ends.[10] P_{jt-1} is the stock price at the beginning of the year t cumulation period. Similarly, ΔX_{jt} are the residuals from a regression of dollar changes in earnings per share (before extraordinary items) for firm j on the changes in the Standard and Poor's index of earnings. R_{jt}, P_{jt-1}, and ΔX_{jt} are adjusted by the consumer's price index in order to mitigate the heteroscedasticity caused by inflation (see Kormendi and Lipe 1987 for a more complete description of the data). Data from 1947–1980 are used to estimate the coefficients of the system (10)-(11) for each of 145 firms. A nonlinear weighted least squares approach is employed.

As mentioned above, the existence of alternative information implies $a_0 \leq (1+PVR)$. Table 1 contains summary statistics for the estimated parameters.

[10] The April-March cumulation has been used in prior studies so that the returns are contemporaneous with the three quarterly and one annual earnings announcements for the year. The correlations between earnings and returns are larger for cumulation periods which begin in year $t-1$ and last longer than 12 months (Collins et al. 1987). However, since the purpose of this paper is to examine the contemporaneous relation between R_t and e_t under the assumption that the market has alternative information, the April-March cumulation is appropriate.

Table 2
Kendall τ Rank Correlations
(n=145 Firms)

	$\hat{a}_{0j}$[1]	$\hat{V}_{ej}$	$\widehat{PVR}_j$	$\hat{V}_{\Delta Pj}$	$\hat{\lambda}_j$	$\widehat{PVR}_j'$
$\hat{V}_{ej}$	$-.371^{a*}$					
$\widehat{PVR}_j$	$.211^{a*}$	$-.256^{a}$				
$\hat{V}_{\Delta Pj}$	.018	$.286^{a*}$	$.005^{*}$			
$\hat{\lambda}_j$	$-.229^{a}$	.083	$-.157^{b}$	$-.001$		
$\widehat{PVR}_j'$	$.285^{a}$	$-.211^{a}$	$.584^{a}$	.015	$-.573^{a}$	
$MEDVAL_j$	$.109^{c}$	$-.083$	.025	$.209^{a}$	$-.041$	.046

[1] $\hat{a}_{0j}$=the estimated response coefficient for firm j.
$\widehat{PVR}_j$=the time-series persistence of earnings for firm j assuming τ=10%.
$\widehat{PVR}_j'$=the persistence of earnings based on firm-specific interest rates.
$\hat{V}_{ej}$=variance of the estimated earnings shocks, $\hat{e}_{jt}$.
$\hat{V}_{\Delta Pj}$=variance of $R_{jt} \times P_{jt-1}$.
$\hat{\lambda}_j$=estimated beta from an annual market model regression.
$MEDVAL_j$=the median value of equity for each firm, j, in millions.

[a] Significant at the .001 level.

[b] Significant at the .01 level.

[c] Significant at the .10 level.

[*] Signifies the four direct tests of the model. These four significance levels are based on one-tailed tests. All other significance levels are based on two-tailed tests.

The mean (median) of $\hat{a}_{0j}$ across the 145 firms is 3.38 (2.50). The mean (median) of $\widehat{PVR}_j$ is 8.93 (7.91). In addition, $\hat{a}_{0j}$ is less than $(1+\widehat{PVR}_j)$ for 144 of the 145 firms. Note that the calculation of $\widehat{PVR}_j$ requires an assumed interest rate for discounting expectations of future earnings; a rate of ten percent is used in Table 1. The results are consistent with equation (6).[11]

Tests of Earnings Predictability

The response coefficient, a_0, is hypothesized to be an increasing function of the predictability of the earnings series. Predictability is reflected in the variance of the earnings shocks, σ_e^2 (as σ_e^2 increases, the predictability decreases). The empirical measure of σ_e^2 for firm j is denoted $\hat{V}_{ej}$, and it equals Var$(\hat{e}_{jt})$, where $\hat{e}_{jt}$ are the estimated residuals from equation (11). The estimates $\hat{a}_{0j}$ and $\hat{V}_{ej}$ can be viewed as random variables, the distribution of which depends on the "true" distribution of a_{0j} and σ_{ej}^2, respectively, and the errors from estimating the parameters for each firm. These estimates are analyzed across firms in order to infer the relation between the "true" a_{0j} and σ_{ej}^2. In testing the hypothesis, the null is that $\hat{a}_{0j}$ and $\hat{V}_{ej}$ are unrelated (or positively related), with the alternative hypothesis that the two are negatively related.

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[11] Since PVR is a decreasing function of the interest rate, assuming an interest rate substantially higher than ten percent will result in $\hat{a}_{0j}$ being greater than $(1+\widehat{PVR}_j)$ for most firms. However, Kormendi and Lipe (1987, 341) report that even if one assumes a rate of 30 percent, $\hat{a}_{0j} < (1+\widehat{PVR}_j)$ for 67 percent of the firms.

Table 3
Kendall Partial Rank Correlations
($n=145$ Firms)

Y	$\text{Corr}(Y, \hat{V}_{ej} \mid \widehat{PVR}_j)$	$\text{Corr}(Y, \widehat{PVR}_j \mid \hat{V}_{ej})$
$\hat{a}_{0j}$	$-.335^a$	$.130^b$
$\hat{V}_{\Delta Pj}$	$.297^a$	$.084^c$

$\hat{a}_{0j}$ = the estimated response coefficient for firm j.
$\widehat{PVR}_j$ = the time-series persistence of earnings for firm j, assuming $r=10\%$.
$\hat{V}_{ej}$ = variance of the estimated earnings shocks, $\hat{e}_{jt}$.
$\hat{V}_{\Delta Pj}$ = variance of $R_{jt} \times P_{jt-1}$.
^{a} Significant at the .001 level (one-tailed test).
^{b} Significant at the .02 level (one-tailed test).
^{c} Significant at the .10 level (one-tailed test).

Because the functional form of the relation between $\hat{a}_{0j}$ and $\hat{V}_{ej}$ is nonlinear, the relation is examined using rank correlations.[12] Table 2 presents the Kendall τ rank correlations for the data. The correlation between $\hat{a}_{0j}$ and $\hat{V}_{ej}$ is $-.371$ with a Z-statistic of -6.6. The correlation is significantly negative at less than the .001 level.[13] The null is rejected in favor of the alternative.

Table 2 shows that the correlation between $\hat{a}_{0j}$ and $(1+\widehat{PVR}_j)$ is significantly positive, which is the same result reported by Kormendi and Lipe.[14] But note that $\hat{V}_{ej}$ and $(1+\widehat{PVR}_j)$ are significantly negatively correlated (rank correlation $= -.256$, $Z=-4.57$). Recall that PVR is a function of the autoregressive coefficients of the earnings series. The negative correlation is apparently showing that firms with less persistent time-series have larger variances of earnings shocks. The theory in Section I makes no prediction regarding the sign or magnitude of the relation between $\hat{V}_{ej}$ and $(1+\widehat{PVR}_j)$, but the negative relation is consistent with Lev's (1983) analysis of economic factors such as whether the firm produces durables or nondurables.

Since $\hat{V}_{ej}$ and $(1+\widehat{PVR}_j)$ are significantly correlated, the simple correlations between $\hat{a}_{0j}$ and these two variables may suffer from an omitted variables bias. In other words, the simple correlation between, say, $\hat{a}_{0j}$ and $(1+\widehat{PVR}_j)$ could be overstated because movements in $(1+\widehat{PVR}_j)$ are proxying for movements in $\hat{V}_{ej}$ (Maddala 1977, 155–157). Therefore, partial rank correlations are presented in Table 3 in order to assess the incremental importance of persistence and predictability. The partial rank correlation between $\hat{a}_{0j}$ and $\hat{V}_{ej}$, given $(1+\widehat{PVR}_j)$, is

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[12] Scatter plots (not reported) show a strong curve in the relation as well as some outliers. The rank correlations are less sensitive to these problems than Pearson correlations or OLS regressions.

[13] Under the null, $Z \sim N(0,1)$. While using rank correlations reduces the impact of outliers and nonlinearities, the test does assume that each pair, $\hat{a}_{0j}$ and $\hat{V}_{ej}$, represent an independent draw. Cross-sectional correlations among the firms could result in the estimated parameters being cross-sectionally dependent, however, the market-wide movements were removed from earnings and returns to reduce this dependency.

[14] The table reports the correlations between various parameters and $\widehat{PVR}_j$, which are the same as the correlations with $(1+\widehat{PVR}_j)$.

$-.335$, with $Z=-5.93$ (significant at .001);[15] again the null is rejected which is consistent with the hypothesis developed in Section I. The correlation between $\hat{\alpha}_{0j}$ and $(1+\widehat{PVR}_j)$, given $\hat{V}_{ej}$, is .130, with $Z=2.30$, which is significant at .02 using a one-tailed test. Thus, both predictability and persistence appear to be significant determinants of the response coefficients.

Section I also analyzed the variance of price changes. The theory shows that $\mathrm{Var}(\Delta P_t)$ should be positively related to both σ_e^2 and $(1+PVR)$. Let $\hat{V}_{\Delta Pj}$ represent the variance of $R_{jt}\times P_{jt-1}$, estimated over time for each firm. Table 2 shows a simple rank correlation between $\hat{V}_{\Delta Pj}$ and $\hat{V}_{ej}$ of .286. Table 3 shows that the partial rank correlation between $\hat{V}_{\Delta Pj}$ and $\hat{V}_{ej}$, given $(1+\widehat{PVR}_j)$, is .297. Both correlations are significant at .001. Thus, the empirical evidence supports the hypothesis of a negative relation between the variance of price changes and the predictability of the earnings series.

The simple rank correlation between $(1+\widehat{PVR}_j)$ and $\hat{V}_{\Delta Pj}$ is essentially zero. The partial correlation between these two variables, given $\hat{V}_{ej}$, is .084 which is significantly different from zero at .07. Persistence is not as strongly related to the variance of price changes as it is to the response coefficient.

Sensitivity Analysis

The empirical tests are joint tests of the null hypotheses and the assumptions. If the assumptions are poor representations of the interactions between accounting earnings, stock prices, and alternative information, then equation (6) will be a poor description of α_0. The major concern is whether the results are spurious. Note, however, that deviations between the model's assumptions and the real world would likely result in a failure to reject the null instead of a spurious rejection. An exception to this general rule is if the assumption involves an omitted correlated variable, as discussed below. Also, because this study uses annual data, it can only test whether the association between returns and earnings are consistent with the hypotheses; the tests cannot determine whether earnings cause returns.

Measurement errors have a subtle effect on the tests. As discussed in Section I, $\hat{\alpha}_{0j}$ is a downwardly biased estimate of $(1+PVR_j)$ because one cannot observe the nonearnings information used by the market. But the inability to measure market expectations does not bias $\hat{\alpha}_{0j}$ away from its theoretical value of $(1+PVR_j)(1-M_j)$. On the contrary, the hypothesized positive relation between $\hat{\alpha}_{0j}$ and $\hat{V}_{ej}$ explicitly incorporates the informational superiority of the market. Therefore, the traditional errors-in-variables bias mentioned in most response coefficient studies (Kormendi and Lipe 1987, 331) can not lead to spurious results in this paper.

The estimate of $\hat{\alpha}_{0j}$ will be affected by errors in specifying the univariate time-series model of earnings. Suppose the estimated earnings shock, $\hat{e}_{jt}$, contains the true shock, e_{jt}, plus measurement error, ϵ_{jt}. The effect of ϵ_{jt} is to bias the $\hat{\alpha}_{0j}$ towards zero, and the bias is an increasing function of $\sigma_{\epsilon j}^2$. But the measurement error also means that $\hat{V}_{ej}=\sigma_{ej}^2+\sigma_{\epsilon j}^2$. If there is substantial cross-firm variation in $\sigma_{\epsilon j}^2$, then firms with larger $\sigma^2_{\epsilon j}$ will have larger $\hat{V}_{\epsilon j}$ but smaller $\hat{a}_{0j}$. Therefore, the negative correlation between $\hat{a}_{0j}$ and $\hat{V}_{\epsilon j}$ could be due to measurement errors in the earnings shocks instead of due to a negative relation between a_0 and σ^2_{ϵ}.

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[15] Maghsoodloo and Pallos (1981) describe hypothesis testing with partial rank correlation. The normal approximations used here are interpolated which might slightly understate the Z-statistic.

Unfortunately, the true earnings shocks and their variance are not observable and, thus, direct resolution of this issue is impossible. However, the results regarding the variance of price changes can provide indirect evidence. Note that $\hat{V}_{\Delta Pj}$ is not a function of $\sigma^2_{\epsilon j}$ because the former is not conditional on the estimated earnings shocks. If a large portion of the cross-sectional variation in $\hat{V}_{\epsilon j}$ is due to $\sigma^2_{\epsilon j}$, then the correlation between $\hat{V}_{\Delta Pj}$ and $\hat{V}_{\epsilon j}$ would be indistinguishable from zero. The empirical results presented above show a sigificant correlation between $\hat{V}_{\Delta Pj}$ and $\hat{V}_{\epsilon j}$, which suggests that $\hat{V}_{\epsilon j}$ captures significant cross-firm variation in $\sigma^2_{\epsilon j}$. This suggests (but does not guarantee) that the significant negative relation between $\hat{a}_{0j}$ and $\hat{V}_{\epsilon j}$ is not spurious.

One assumption that could lead to spurious correlation is the cross-sectionally constant interest rate assumption. Differences in interest rates would reflect differences in risk. Omitting firm-specific risk affects the tests in two ways. First, if r varies across firms, then $\widehat{PVR}_j$ as calculated above is incorrect. To assess the severity of this error, the estimated market model beta of firm j, denoted $\hat{\lambda}_j$, is used to calculate a firm-specific interest rate, $\hat{r}_j$.[16] Table 2 shows that the new persistence measure, $\widehat{PVR}_j'$, and the original measure, $\widehat{PVR}_j$, are significantly correlated. The simple rank correlations between $\widehat{PVR}_j'$ and both $\hat{a}_{0j}$ and $\hat{V}_{\Delta Pj}$ actually increase, and the partial correlation between $\widehat{PVR}_j'$ and $\hat{a}_{0j}$, given $\hat{V}_{\epsilon j}$, is more significant than before. Thus, incorporating firm-specific risk into persistence appears to provide stronger results.

The second effect of differential risk is that if my valuation assumptions are not valid, a_0 may be related to risk in ways other than in equation (4). Indeed, Collins and Kothari (1989) find that the estimated response coefficient is negatively related to the firm's stock market beta. Table 2 shows that the rank correlation between $\hat{a}_{0j}$ and $\hat{\lambda}_j$ is $-.229$ (significant at the .001 level). However, the partial correlation between $\hat{a}_{0j}$ and $\hat{\lambda}_j$, given $\widehat{PVR}_j'$, is only $-.084$ (significant at the .07 level, using a one-tailed test). Thus, once *PVR* is adjusted for differences in $\hat{\lambda}_j$, the incremental explanatory power of $\hat{\lambda}_j$ is greatly reduced. Another concern is that $\hat{V}_{\epsilon j}$ could be proxying for $\hat{\lambda}_j$. But this is not the case as the rank correlation between $\hat{V}_{\epsilon j}$ and $\hat{\lambda}_j$ is .083 which is not significantly different from zero at the .10 level (two-tailed test). In addition, the partial correlations of $\hat{a}_{0j}$ and $\widehat{PVR}_j$, $\hat{a}_{0j}$ and $\hat{V}_{\epsilon j}$, and $\hat{V}_{\Delta Pj}$ and $\hat{V}_{\epsilon j}$, given $\hat{\lambda}_j$, are all significant in the predicted direction. Thus, the primary results of this paper are probably not driven by omitting cross-sectional differences in risk.

Another potential omitted factor is firm size. The contemporaneous relation

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[16] The calculation of $\hat{r}_j$ is as follows:

$$\hat{r}_j = .01 + .09 \times \frac{\hat{\lambda}_j}{\left[\sum_{k=1}^{145} \hat{\lambda}_k\right] / 145}.$$

Thus, the average $\hat{r}_j$ is still ten percent. But now, 90 percent of each firm's interest rate is determined based on $\hat{\lambda}_j$, and ten percent is a constant. Using factors other than .01 and .09 yields similar results.

between returns and earnings has been shown to differ with size (Collins et al. 1987; Freeman 1987). The firms are ranked according to their median market value of equity over the 1947–1980 period, denoted $MEDVAL_j$. Table 2 shows that the correlation between $MEDVAL_j$ and both $\hat{a}_{0j}$ and $\hat{V}_{\Delta P_j}$ are significantly positive. However, size is not significantly correlated with $\widehat{PVR}_j$ or $\hat{V}_{e_j}$. Partial rank correlations (not reported) confirm that the inferences drawn above regarding the effects of persistence and predictability do not appear to be driven by size.[17] These results regarding size may not generalize to the population of firms, however, because this sample contains NYSE firms that survived for at least 34 years.

III. Extensions

Previous sections developed and tested specific hypotheses regarding the impact of alternative information. This section examines some of the other benefits of assuming that the market has information other than earnings. First, a model which includes alternative information can address the information environment hypothesis and other issues in a more formal way. Second, since the differences in the information sets observed by the market and the researcher are explicit in the model, one can assess whether *ad hoc* ways of dealing with measurement errors will be useful. Third, while the assumed link between future earnings and future dividends is without error, the existence of alternative information suggests that economic earnings differ from accounting earnings, and the difference is negatively autocorrelated.

Adding alternative information to an existing model of returns implies that the relation between returns and earnings is a function of the predictability of the earnings series. But equation (4) also shows that the relation depends on σ_n^2, the ability of the alternative information to predict future earnings. For example, an increase in σ_n^2 means that I_t is not as useful in predicting e_{t+1} and, therefore, a_0 increases. The negative relation between the predictive ability of alternative information and the response coefficient is similar to the information environment hypothesis (e.g., Atiase 1985, 1987; Collins et al. 1987; Collins and Kothari 1989; Freeman 1987; McNichols and Manegold 1983). The difference is that the latter is usually stated in terms of the quantity of alternative information, whereas the former is based on the predictive ability or "quality" of the alternative information. Thus, including proxies for how well future earnings can be predicted by alternative information may be useful in testing the information environment hypothesis. Also, one could test whether cross-sectional differences in size, the predominant proxy for differences in information environments, becomes insignificant when cross-sectional differences in σ_n^2 are controlled. Note that prior studies of the information environment hypothesis generally do not derive their tests from a theoretical model of the relation between returns and earnings, whereas the importance of σ_n^2 is a direct implication from equation (4).

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[17] The results of the four hypotheses tests are similar if mean, beginning-of-period, end-of-period, or middle-of-period value is used instead of the median. However, the correlation between $\hat{a}_{0j}$ and size is not significantly positive for all definitions.

As to measurement error, a_0 is a function of $(1-M)$ because the researcher does not perfectly measure the information used by the market. One way of expressing this is that a_0 is a biased estimate of the true parameter of interest, $(1+PVR)$. But note that reverse regression will also yield biased estimates of $(1+PVR)$. To see this, rewrite equation (4) as:

$$\frac{e_t}{P_{t-1}}=k_1+k_2R_t+Ue_t,$$

$$=k_1+k_2R_t^*+k_2(1+PVR)\frac{e_t-Mw_t+\beta Mw_{t+1}}{P_{t-1}}+Ue_t. \qquad (12)$$

Ue_t is the residual, and k_1 and k_2 are the reverse regression coefficients. Assuming that R_t^* is a constant and that scaling dollar returns and dollar earnings shocks by P_{t-1} does not affect the expected value of k_2,[18] the value of the reverse regression estimate of a_0, a_0^*, can be determined as follows:

$$a_0^*=\frac{1}{k_2}=\frac{1-(1-\beta^2)M}{1-M}(1+PVR). \qquad (13)$$

Thus, a_0^* is a biased estimate of $(1+PVR)$, and the bias depends on M. Since

$$\frac{1-(1-\beta^2)M}{1-M}\geq 1,$$

the bias is away from zero. The bias occurs because R_t includes βMw_{t+1} which is the revision in expectations of e_{t+1}. Since βMw_{t+1} is uncorrelated with e_t, a portion of the independent variable in equation (12) is uncorrelated with the dependent variable leading to the classic errors-in-variables bias in k_2. Therefore, even if the earnings shocks and stock returns are measured without error, the reverse regression produces biased estimates of $(1+PVR)$ because stock returns reflect information about next year's earnings shock.[19] Again, this becomes apparent when the market is assumed to observe alternative information.

Brown et al. (1987) suggest an alternative control for measurement errors using returns prior to the cumulation period for R_t as a second independent variable in equation (6). This procedure should reduce the errors-in-variables bias if prior returns are correlated with the measurement error in the proxy for unexpected earnings but are uncorrelated with current-period returns or the market's unexpected earnings. Here the difference between e_t and the market's assessment of unexpected earnings equals Mw_t. Equation (4) shows that R_{t-1} will be correlated with Mw_t. Further, R_{t-1} is uncorrelated with e_t-Mw_t and R_t. Therefore, the model in this paper suggests that the Brown et al. method should be useful.[20]

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[18] These assumptions simplify the analysis. If they do not hold, the bias in k_2 will be more complex, but still exists.

[19] Beaver et al. (1987, 150–151) state that the reverse regression will not provide unbiased coefficients if stock price changes reflect information other than current-period earnings. This analysis shows that such a bias is to be expected.

[20] Using quarterly data and a maximum return cumulation period of 40 trading days, Brown et al. (1987) report modest improvements from including lagged returns.

Equation (4) also has implications for studies which analyze the differences between economic earnings and accounting earnings (Beaver et al. 1980; Beaver et al. 1987).[21] In these models, stock price is a function of economic earnings (which is unobservable to the researcher) and accounting earnings equals economic earnings for the period plus noise. This paper does not explicitly address the noise in accounting earnings because I assume a direct link between the revisions in expectations of dividends and earnings. However, the new information provided by accounting earnings alone, e_t, is not equal to economic earnings. The difference between the economic earnings of year t and e_t is:

$$(e_t - Mw_t + \beta Mw_{t+1}) - e_t = \beta Mw_{t+1} - Mw_t. \tag{14}$$

Equation (14) demonstrates that economic earnings lead accounting earnings. Further, the difference is negatively autocorrelated. The reason is that the income from a given transaction will be recognized by both accounting earnings and economic earnings, but the recognition can take place in different years. For example, if economic earnings recognize a portion of a transaction's income in year t and the remaining portion in year $t+1$ while accounting earnings recognize all of the income in period $t+1$, the difference between the two must be negatively autocorrelated.[22] Thus, by assuming that the market has alternative information, one difference between economic and accounting earnings becomes clear.

IV. Conclusions

This study examines the theoretical relation between stock returns and accounting earnings, assuming that the market has a second source of current-period information in addition to earnings. Theoretically, the stock return during the period is a function of (1) the time-series persistence of the earnings series, (2) the interest rate used in discounting expected future earnings, and (3) the relative ability of earnings versus alternative information to predict future earnings. Comparative statistics show that the response coefficient is an increasing function of the ability of past earnings to predict future earnings and an increasing function of persistence. In addition, the variance of stock price changes conditional on earnings being announced is a decreasing function of the predictability of the earnings series and an increasing function of earnings persistence. The predictability/response-coefficient effect is positive because the value attached to a one-dollar current-period earnings shock is an increasing function of predictability. The predictability/variance-of-price-changes effect is negative because the average quantity of unexpected information released during the period is a decreasing function of predictability.

The sample from Kormendi and Lipe (1987) was used for direct tests of these four hypotheses, with three being supported by the data. The exception is that the variance of price changes is only weakly related to earnings persistence. Sensitivity analysis suggests that the results are not driven by omitting risk and size from the empirical tests. Also, by explicitly including alternative information in formulating the hypotheses, the results cannot be attributed to errors in measuring market expectations. But other econometric problems cannot be resolved and, therefore, the strength of the results may be overstated.

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[21] Some studies refer to economic earnings as "permanent" earnings. Whatever the name, the construct is that number which is valuation sufficient. Also, the difference between economic earnings and accounting earnings is usually termed "garbling."

[22] See Beaver (1970) for a more detailed discussion of how differences between accounting and economic earnings will be serially correlated.

The model presented and tested in this paper extends the results from previous work. First, existing empirical evidence that earnings shocks in year $t+1$ are correlated with stock returns in year t suggests modelling the alternative information as a noisy signal of future earnings. Second, previous models and the associated empirical tests demonstrate the importance of earnings persistence. Third, models of how rational individuals assess expectations based on competing sources of information suggest that predictive ability determines the extent to which a given signal is used. Combining these elements provides new insights into the relation between stock prices and accounting earnings.

Appendix

This appendix contains detailed derivations of the theoretical model. Stock price is assumed to equal the present value of expected future dividends, or:

$$P_t=\sum_{s=1}^{\infty}\beta^s[E_t(D_{t+s})]. \tag{A.1}$$

In equation (A.1), P_t is the stock price per share in period t, E_t represents the expectations conditional on all information available at time t, D_{t+s} is the dividend paid to equity holders in period $t+s$, and $\beta=1/(1+\tau)$, where τ is the appropriate rate of interest for discounting expected future dividends. Dividends are used in equation (A.1) because, as Ohlson (1988, 29) points out, "ultimately only payoffs count, and dividends alone can be consumed." The discount rate is assumed constant across time for simplicity.

Total stock returns can be decomposed into expected and unexpected components as follows:

$$\begin{aligned} R_t&=\frac{P_t-P_{t-1}+D_t}{P_{t-1}}\\ &=\frac{E_{t-1}(P_t)-P_{t-1}+E_{t-1}(D_t)}{P_{t-1}}+\frac{P_t-E_{t-1}(P_t)+D_t-E_{t-1}(D_t)}{P_{t-1}}=R_t^e+R_t^u. \end{aligned} \tag{A.2}$$

This analysis focuses on R_t^u, the portion of the return in period t that is unexpected based on the information available in period $t-1$. Combining equations (A.1) and (A.2) yields:

$$R_t^u=\sum_{s=0}^{\infty}\beta^s\frac{E_t(D_{t+s})-E_{t-1}(D_{t+s})}{P_{t-1}}. \tag{A.3}$$

In order to bring accounting earnings directly into equation (A.3), the present value of the revisions in expected dividends are assumed to equal the present value of the revisions in expected accounting earnings, in which case:

$$R_t^* = \sum_{s=0}^{\infty} \beta^s \frac{E_t(X_{t+s}) - E_{t-1}(X_{t+s})}{P_{t-1}}. \tag{A.4}$$

Obviously the assumption will not hold exactly and, thus, there is some error introduced in equation (A.4). These errors will affect the empirical tests, but without knowing exactly how the present value of the revisions in expectations of accounting earnings and dividends differ, it is impossible to accurately predict the magnitude or even the direction of the effect.

Equation (A.4) determines the magnitude of the return conditional on the new information released during period t. Equations (2) and (3) in the text describe the information structure. The earnings series is assumed to follow a first-differenced, finite-order autoregressive process. The autoregressive coefficients, b_l, are assumed to be known by both the market and the researcher. The shock (or innovation) in the earnings series, e_t, is assumed to be unconditionally distributed $N(0, \sigma_e^2)$. The normality assumption is convenient later in calculating conditional expectations. The alternative information provides a noisy signal of future earnings. The noise, n_{t+1}, is assumed to be distributed $N(0, \sigma_n^2)$. Also, e_{t+l} and n_{t+k} are assumed to be independent, for all l and k. I_t and X_t are observed simultaneously because tests in the paper use annual data.

To understand the contemporaneous relation between returns and earnings, the revisions in the expections of X_{t+s} in equation (A.4) must be restated. It is helpful to rewrite X_t in its infinite-order moving-average form, as follows:

$$X_t = \theta(L) e_t, \tag{A.5}$$

where $\theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \ldots$, and L is the lag operator. The θ coefficients come from inverting equation (2) into a moving-average process. The relation between θ_j and b_l will be demonstrated later. Using equation (A.5), the revision in the expectation of X_{t+s} is:

$$E_t(X_{t+s}) - E_{t-1}(X_{t+s}) = E_t[\theta(L) e_{t+s}] - E_{t-1}[\theta(L) e_{t+s}]$$

$$= \sum_{j=0}^{\infty} \theta_j [E_t(e_{t+s-j}) - E_{t-1}(e_{t+s-j})]. \tag{A.6}$$

Equation (A.6) can be simplified by determining what new information is released in period t. Note that all past realizations (X_{t-l} and I_{t-l}, $l = 1 - \infty$) are known prior to period t. Thus, the release of X_t implies that the value of e_t is revealed. Further, combining equations (2) and (3) yields:

$$I_t = X_{t+1} + n_{t+1} = X_t + \sum_{l=1}^{N} b_l \Delta X_{t+1-l} + e_{t+1} + n_{t+1}. \tag{A.7}$$

Since the only unknowns on the right-hand side of equation (A.7) are e_{t+1} and n_{t+1}, the release of X_t and I_t together implies that the sum $(e_{t+1} + n_{t+1})$ is also revealed. Note that investors *do not* know e_{t+1} or n_{t+1} individually in period t. For notational convenience, let $w_{t+1} = e_{t+1} + n_{t+1}$. Expanding the right-hand side of equation (A.6) shows that:

$$\begin{aligned}\sum_{j=0}^{\infty}\theta_j[E_t(e_{t+s-j})-E_{t-1}(e_{t+s-j})] \\ &=\sum_{j=0}^{s-2}\theta_j[E_t(e_{t+s-j})-E_{t-1}(e_{t+s-j})] \\ &\quad+\theta_{s-1}[E_t(e_{t+1})-E_{t-1}(e_{t+1})]+\theta_s[E_t(e_t)-E_{t-1}(e_t)] \\ &\quad+\sum_{k=1}^{\infty}\theta_{s+k}[E_t(e_{t-k})-E_{t-1}(e_{t-k})]. \qquad \text{(A.8)}\end{aligned}$$

The summation over $j=0$ to $s-2$ equals zero because e_t and w_{t+1} provide no new information about the earnings shocks in period $t+2$ or thereafter. The summation over $k=1$ to ∞ also equals zero because earnings shocks in or before period $t-1$ are already known. Thus, only the two middle terms will be nonzero, which yields:

$$\begin{aligned}E_t(X_{t+s})-E_{t-1}(X_{t+s})=&+\theta_s[E_t(e_t)-E_{t-1}(e_t)] \\ &+\theta_{s-1}[E_t(e_{t+1})-E_{t-1}(e_{t+1})]. \qquad \text{(A.9)}\end{aligned}$$

Disclosing e_t and w_{t+1} causes the market to revise its expectations of e_t and e_{t+1}. Equation (A.9) shows that the revision in the expectation of $e_t(e_{t+1})$ leads to a revision in the expectation of X_{t+s}, and the magnitude of the latter revision is determined by $\theta_s(\theta_{s-1})$.

Substituting equation (A.9) into equation (A.4) and rearranging terms shows that:

$$\begin{aligned}R_t^u=&\left(1+\sum_{s=1}^{\infty}\beta^s\theta_s\right)\frac{E_t(e_t)-E_{t-1}(e_t)}{P_{t-1}} \\ &+\beta\left(1+\sum_{s=1}^{\infty}\beta^s\theta_s\right)\frac{E_t(e_{t+1})-E_{t-1}(e_{t+1})}{P_{t-1}}. \qquad \text{(A.10)}\end{aligned}$$

Equation (A.10) can be simplified in two ways. First, the discounted sum of the moving average coefficients captures how current information impacts expectations of future earnings. This sum is referred to as the time-series persistence of earnings and is denoted *PVR*, in order to be consistent with the notation in Kormendi and Lipe (1987). They demonstrate that this sum is a function of the b_i coefficients, as follows (pp. 329–330):

$$\sum_{s=1}^{\infty}\beta^s\theta_s\equiv PVR=\frac{1}{(1-\beta)(1-\sum_{i=1}^{N}\beta^i b_i)}-1. \qquad \text{(A.11)}$$

Second, under the assumption that e_t and n_t are distributed $N(0,\sigma_e^2)$ and $N(0,\sigma_n^2)$, respectively, $E_{t-1}(e_t)$ has the following convenient representation:

$$E_{t-1}(e_t)=\frac{\sigma_e^2}{\sigma_e^2+\sigma_n^2}w_t. \qquad \text{(A.12)}$$

To prove this, recall that the unconditional expectation of e_t equals zero. But at time $t-1$, the market knows $w_t=e_t+n_t$. Since e_t and n_t are independent and normally distributed, w_t is also normally distributed. The expectation of e_t conditional on w_t is then:

$$E_{t-1}(e_t)=\mu_e+\rho\frac{\sigma_e}{\sigma_w}(w_t-\mu_w). \tag{A.13}$$

In equation (A.13), μ_e (μ_w) equals the unconditional expectation of e_t (w_t); σ_e (σ_w) equals the standard deviation of e_t (w_t); and ρ equals the correlation between e_t and w_t. Since

$$\sigma_w=\sqrt{\sigma_e^2+\sigma_n^2} \quad \text{and} \quad \rho=\frac{\sigma_e}{\sqrt{\sigma_e^2+\sigma_n^2}},$$

equation (A.12) holds. For convenience, let

$$M=\frac{\sigma_e^2}{\sigma_e^2+\sigma_n^2}.$$

Using equation (A.12), the revisions in expectations of e_t and e_{t+1} are as follows:

$$\begin{aligned} E_t(e_t)-E_{t-1}(e_t)&=e_t-Mw_t,\\ E_t(e_{t+1})-E_{t-1}(e_{t+1})&=Mw_{t+1}-0. \end{aligned} \tag{A.14}$$

These two simplifications transform equation (A.10) as follows:

$$R_t^*=(1+PVR)\frac{[e_t-Mw_t+\beta Mw_{t+1}]}{P_{t-1}}. \tag{A.15}$$

Equation (A.15) represents how new information impacts stock returns.

The relation between returns, earnings, and alternative information in equation (A.15) presumes that X_t and I_t are observed simultaneously. While this is appropriate when annual returns are used, the model could be specified differently. For example, if returns are cumulated over a few days surrounding the earnings announcement, then one would naturally assume that X_t is released during the cumulation period. However, the relation in equation (A.15) would hold for the short cumulation period only if the alternative information is released during the cumulation period and no information is released between cumulation periods. A more reasonable assumption is that I_t is revealed during the time between cumulation periods and X_t is released during the cumulation period. This leads to a sequential release of information that is similar to the sequence considered by Holthausen and Verrecchia (1988).

If information is released sequentially, then the form of equation (A.15) changes, and the change depends on the alternative information assumption (eq. [3]). For example, one could replace equation (3) with:

$$I_t=X_t+n_t. \tag{A.16}$$

In this case, I_t reveals e_t+n_t at the beginning of period t instead of revealing $e_{t+1}+n_{t+1}$. The relation between returns cumulated over the short period of time and e_t will still be a function of M, so the predictability effect is still present. But the correlation between R_t and e_{t+1} is zero. Thus, the lagged return effect that motivates the form of equation (3) is eliminated by assuming equation (A.16).

If one maintains equation (3) and also assumes sequential information, then the model becomes much more cumbersome. At the beginning of period t, I_t reveals information about e_t and e_{t+1}. At the end of the period, X_t resolves all uncertainty regarding e_t and provides additional information about e_{t+1}. Thus, there are multiple sources of information regarding e_{t+1} which complicates the conditional expectations. In general, the relation between returns and earnings is still determined by both predictability and persistence. Also, R_t is still correlated with e_{t+1}.

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Experience Effects in Auditing: The Role of Task-Specific Knowledge

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ABSTRACT: Previous studies concerning experience effects in audit judgments have produced mixed results, possibly because they did not consider the knowledge necessary to complete the task and when it would normally be acquired. Further, many studies did not view the global judgment process as consisting of several components, e.g., cue selection. Task-specific knowledge may aid the performance of experienced auditors more in some components than in others. Not considering task-specific knowledge or viewing the judgment process as being comprised of components may have led to certain problems in generalizing the results of these studies to other auditing tasks. Those problems are addressed in the design of this study, which examines experience effects, specifically the role of task-specific knowledge, in the cue selection and cue weighting components of two audit tasks, analytical risk assessment and control risk assessment. Results indicate that task-specific knowledge aided the performance of experienced auditors in both the cue selection and cue weighting components only in analytical risk assessment.

MEASUREMENT of audit judgment performance is often difficult because there are no objective performance criteria for many audit tasks. As a result, the judgments of experienced auditors have been used as a substitute for other performance measures in determining firm policies and auditing standards. To determine the validity of this criterion, more evidence is needed

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regarding why experienced auditors can perform tasks that inexperienced auditors cannot. Also, auditors with differing levels of experience are normally assigned to different tasks. Understanding the basis for these resource allocation decisions requires understanding of the nature of experience-related performance differences and the knowledge differences that underlie them (Libby and Frederick 1989).

Evidence regarding the effects of experience on audit judgments is somewhat mixed (see Wright 1988 for a review). As noted by Frederick and Libby (1986), these mixed results may have arisen because some studies did not consider the knowledge required to perform the experimental tasks, when that knowledge would be acquired (or the experience level of auditors who normally perform the task), and how this knowledge would be brought to bear upon the task. Further, many studies did not view the judgment process as being composed of several components, specifically cue selection, cue measurement, and cue weighting and combination (Lewis et al. 1983). Task-specific knowledge may aid the performance of experienced auditors in some components of judgments and not in others.

Not considering task-specific knowledge in general or its effects on various components of judgments has led to at least four problems in generalizing the results of these studies. First, some studies finding no experience effects used experimental tasks for which the designated experienced and inexperienced auditors both possessed the requisite knowledge (e.g., Ashton and Brown 1980; Hamilton and Wright 1982). Second, some studies may not have obtained experience effects because the experimental tasks did not contain the components in which knowledge acquired through experience would most aid performance, e.g., cue selection (Ashton and Brown 1980; Hamilton and Wright 1982). Third, studies finding a main effect for experience in one task may have demonstrated something other than task-specific knowledge differences, such as superior ability of experienced auditors at all tasks (e.g., Moriarity 1979). Finally, other studies with main effects for experience in multiple tasks may have confounded knowledge differences and task differences (Abdolmohammadi and Wright 1987).

To reduce the problems of generalizing the results described above, two experiments examine experience effects in, respectively, the cue selection and cue weighting components of two audit tasks, analytical procedure risk assessment and control risk assessment.[1] By addressing these issues, this study provides further understanding of the nature of experience effects in auditing, particularly the role of task-specific knowledge in general and its effect on performance in two components of these audit tasks. It also presents some preliminary evidence on how auditors make assessments of analytical procedure risk.

The next section reviews the literature on experience effects and describes the approach taken to study experience effects. Following this, the design and results of the two experiments are presented. A final section discusses the study's implications and limitations.

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[1] The audit risk model provides a framework for planning audit tests, as follows (AICPA 1983). It includes components for control risk, or risk that the accounting control system will fail to prevent or detect a material error, if one occurs and analytical procedure risk, or risk that analytical procedures will fail to detect a material error, if one occurs and is not detected by the control system. Control risk is a function of the attributes of the control system. Analytical risk is dependent on how effective the analytical procedures will be at detecting errors.

Problem Development

Experience Effects in Audit Judgments

As stated above, many previous studies on experience effects in auditing have not considered the role of task-specific knowledge, nor how task-specific knowledge can affect performance in various components of judgments. This has led to at least four problems in generalizing their results. First, some studies chose an experimental task for which the designated experienced and inexperienced auditors both possessed the knowledge necessary to perform the task, leading to findings of no experience effects. For example, Ashton and Brown (1980) divided subjects at one year, two years, and three or more years in their analysis of experience effects in evaluating payroll control system quality. There were no significant correlations between experience and multiple performance measures, such as judgment variance explained. One reason for high agreement among auditors across experience levels was that they put most weight on the separation-of-duties cues. The concept of separation of duties is one of the first taught in auditing courses and firm training. Thus, it is likely that auditors with one to three years of experience would all have had knowledge of the relative importance of those cues. Hamilton and Wright (1982) found similar results using experience levels of less than three years and greater than three years.

Second, some studies used tasks where there should be experience-related knowledge differences for the global judgment, but may have found no experience effects because the experimental tasks omitted components where knowledge would most aid performance. For example, Ashton and Brown (1980) preselected and premeasured cues for their subjects. As noted above, it is likely that inexperienced auditors would have already learned the relative importance of various controls over payroll and, therefore, have been able to perform as well as experienced auditors in judging control strength based only on weighting and combining cues. However, psychology literature (e.g., Johnson et al. 1981) predicts that inexperienced auditors would have difficulty in cue selection, so that there might be experience-related performance differences if all tasks components were to be performed. Similar situations may have occurred in Hamilton and Wright (1982) and Gaumnitz et al. (1982). Furthermore, in a recent study, partners and managers of several large firms provided mean ratings between 1.3 and 2.9 years for years of experience required to perform internal control tasks (Abdolmohammadi 1989). These ratings suggest that experience levels chosen by, for example, Hamilton and Wright (1982) are appropriate for internal control tasks which include all components.

Third, studies that found experience effects in one task may have demonstrated something other than experience-related knowledge differences. For example, Moriarity (1979) found better performance by experienced auditors at bankruptcy prediction; this may have simply reflected superior ability of experienced auditors at all tasks. In fact, in that study, experienced auditors did better than students at predicting bankruptcy with two presentation formats. Thus, it may be necessary to study experience effects by varying both experience levels and tasks.

A few studies have varied both tasks and experience levels. Butt (1988) compared experienced and inexperienced auditors' performance at judging the frequency of financial statement errors and vocabulary words. Experienced auditors were better than inexperienced auditors at judging the relative frequency of financial statement errors, but there were no experience effects for words. Marchant (1987) compared the ability of experienced and inexperienced auditors to use analogical reasoning in generating a potential explanation for an unexpected fluctuation encountered during analytical review. Because reasoning ability differences could have been confounded with knowledge differences, subjects were also asked to complete a general analogies test. His results indicated experience effects in the auditing task, but not in the general analogies task. Although these studies controlled for the effects of experience-related differences other than knowledge, they did not vary audit tasks, so that it is still not clear whether experienced auditors simply have superior ability at all *audit* tasks.

Two studies have varied audit tasks as well as experience levels. Abdolmohammadi and Wright (1987) used multiple audit tasks, that varied on "task complexity"[2] from "structured" to "unstructured," and varied the experience levels of auditors who performed those tasks. Although they considered when, in practice, auditors would normally perform the tasks in question, the mean experience level possessed by "inexperienced" and "experienced" auditors in each task was not constant across tasks. Their study, then, was an attempt to examine the main effect of experience separately in each of three tasks. They hypothesized and found a main effect in the "semi-structured" and "unstructured" tasks; because the judgment in the "structured" task was dependent on the judgment in the "semi-structured" task, the results for the "structured" task were not interpretable. The tasks, however, differed on dimensions other than the amount of structure, e.g., components. For example, the "semi-structured" and "unstructured" tasks required cue measurement, whereas the "structured" task did not. Furthermore, the experience levels that constituted experienced and inexperienced auditors may not have been appropriate in each task. Because there were multiple subject differences and task differences across tasks, it is difficult to determine whether main effects for experience were due to knowledge differences, other subject differences, task structure differences, other task differences (such as components), or some combination of the four.

Frederick and Libby (1986) compared experience effects across tasks which were the same except for the internal control weakness given as part of the background information; the experience levels for experienced and inexperienced auditors were also the same across tasks. They did not, then, have the potential confounding problems described above. They predicted and found that experienced auditors' knowledge of internal control weakness-financial statement error links led them to judge the probability of a conjunction of two errors to be higher than the probabilities of both constituent events (each error). Inexperienced auditors only judged the conjunction's probability to be higher than that of one of the constituent events. These judgment differences were found in both control weakness situations, demonstrating the role of task-specific knowledge in producing experience effects. Frederick and Libby addressed the issues of: (1) choosing appropriate experience levels to study experience effects for a specific task, (2) varying audit tasks as well as experience levels to learn about task-specific knowledge, and (3) holding task characteristics and experience levels constant across tasks so as not to confound task differences and knowledge differences. They did not exclude components from a task, as their subjects made only global judgments.

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[2] The terms "complexity" and "structure" are used to describe many different concepts. Abdolmohammadi and Wright (1987) specifically refer to the Simon (1960) model of decision processes, wherein structure refers to the extent of definition of the problem and cues, the number and specification of alternatives, and amount of judgment needed to make the decision, and complexity refers to amount of structure.

Approach for Studying Experience Effects

In this study, experience effects are investigated by varying experience levels and audit tasks, while holding task characteristics other than experience-related knowledge differences constant. Components in which knowledge acquired through experience is expected to aid performance (cue selection and cue weighting) are included in the tasks.

Two experience levels are used to determine the performance effects of experience-related knowledge differences. Two tasks with similar characteristics, but differing knowledge requirements (analytical procedure risk assessment and control risk assessment), are used to provide added controls for the effects of *subject* differences other than knowledge that might be related to experience, e.g., reasoning ability and personality (Shanteau 1984). As discussed above, if only one task is used, these other experience-related differences could produce a main effect for experience, and either disguise the lack of knowledge differences, or be confounded with the presence of knowledge differences. Here, however, since experienced and inexperienced auditors perform both tasks and since knowledge differences should be small in one task and large in the other, there should be an experience-task interaction. Other experience-related differences would create an interpretation problem only if they are expected to produce this same interaction. That is unlikely because factors such as general ability differences or personality differences would produce a main effect for experience across tasks. Thus, by comparing the experience-related performance differences across tasks that differ only on experience-related knowledge differences, most other explanations for experience effects are ruled out.

Analytical procedure risk assessment and control risk assessment were chosen because they meet the criteria specified above. That is, they have similar characteristics and there should be large experience-related knowledge differences about analytical risk, but small knowledge differences about control risk. Similar characteristics of the tasks include structure, components, and type of task. These tasks are both "semi-structured," as defined by Abdolmohammadi and Wright (1987). That is, they both have reasonably well-defined cues, a limited number of alternatives for output (e.g., low, medium, or high), and some judgment is needed.[3]

Further, the tasks have similar components. They both require cue selection, cue measurement, and cue weighting and combination. In the control risk task, an auditor selects the appropriate cues (specific controls for an account or transaction cycle), either from memory or using a memory aid such as an audit manual. He or she then collects auditee-specific measures on those cues and combines the measured cues to form a risk assessment. In the analytical risk task, an auditor considers what analytical procedures may be performed and selects the cues that are appropriate to analytical risk assessment (characteristics of the procedures). Again, these cues may be retrieved from memory or from an audit manual. He or she then determines (measures) how much of each characteristic the planned procedures possess and weights and combines the cues to make an assessment of analytical procedure risk.[4] Tasks with components as described above constitute "description" tasks (Smith 1988). Since the tasks here are similar on structure, components, and type of task, task differences and knowledge differences will not be confounded.

Finally, there should be large experience-related knowledge differences about analytical procedure risk assessment, but small knowledge differences about control risk assessment, specifically for the components of cue selection and cue weighting. In general, auditors acquire knowledge of relevant cues and how to weight them for judgment tasks by several means including collegiate auditing courses, audit firms' training programs, performance of the tasks in question, or by reviewing other auditors' performance of the tasks.

For the control risk task in this study, both experienced and inexperienced auditors[5] will have had college and audit firm training about the relevance and weighting of cues. Both groups of auditors will also have had experience evaluating controls. No predictions are made about experience-related performance differences in the control risk task alone, as those differences are not the focus of this study. It is possible that such differences exist, as experienced auditors may have had more firm training and certainly will have had more experience in reviewing others' control risk assessments. It is assumed, however, that because inexperienced auditors (as defined by this study) currently perform this task, their knowledge of the task is above some critical threshold and additional experience would not significantly improve their performance.

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[3] These observations are based on a review of audit firm manuals and standard audit workpaper forms (Touche Ross 1978; Peat Marwick 1983; Ernst and Whinney 1986).

[4] These characterizations of the task are based on review of audit manuals and conversations with partners and managers. This does not imply that all auditors perform the tasks in this way. Anecdotally, in experiments conducted for Bonner (1988), subjects who had to measure cues in a judgment task seemed to first measure the cues, then combine them; that is, there were symbols such as "+" and "−" written on the instruments indicating that measurement was performed first, then combination.

[5] An experienced auditor is one who has training and extensive experience in both control risk and analytical risk assessments; such experience is held by managers (auditors with about five to seven years of experience). An inexperienced auditor is one who has extensive training and some experience in control risk assessment and minimal to no training or experience in analytical risk assessment. Staff auditors with two years of experience meet this criterion. These definitions are used to be consistent with the approach used here for studying experience effects.

For the analytical risk task, experienced and inexperienced auditors will have had similar collegiate training. Experienced auditors are expected to have had significantly more firm training than inexperienced auditors, as well as significantly more experience in both the assessment of analytical procedure risk and the review of others' assessments of analytical risk. Thus, experienced auditors are expected to have more complete knowledge of this task. Data collected on postexperimental questionnaires confirmed these expectations regarding training and experience for both tasks.

Experience Effects in Cue Selection and Cue Weighting

The components of the control risk and analytical procedure risk tasks to be studied are cue selection and cue weighting. Cue selection is included, as many psychology researchers agree that experience is important for superior performance in cue selection (e.g., Einhorn 1974; Dawes 1979). Yet, little empirical work has been conducted to support that idea. Cue weighting is studied as there are mixed results and opinions in both psychology and accounting as to the importance of experience therein (e.g., Slovic 1969; Dawes 1979).

Although no psychology research has directly addressed how experienced and inexperienced subjects differ in the retrieval and selection of cues, there are several related studies. The hypothesis generation literature (e.g., Johnson et al. 1981) concludes that inexperienced subjects have difficulty at the cue selection stage because they have incomplete knowledge bases. As Slovic et al. (1971, 18) note, "much of the inaccuracy of judgments can be traced to . . . the failure to recognize the relevant diagnostic signs." Dawes (1979, 394) states that a "model cannot replace the expert in deciding such things as 'what to look for'," and Einhorn (1974) included identification of relevant cues among the components of tasks he believed to be aided by experience. Johnson et al. (1984) also note that the ability to recognize relevant cues may be one of the hallmarks of superior performance by experienced subjects.

As discussed previously, experienced auditors should have much more knowledge than inexperienced auditors about the relevant analytical procedure risk cues via their training and performance of the task, and only slightly more knowledge about relevant control risk cues. Any current memory model (e.g., Anderson 1983) would predict that judges who have more complete knowledge (a simple content difference) would be better able to recognize relevant cues than those who have less complete knowledge and, thus, perform better at cue selection. Therefore, the following hypothesis is suggested:

> H1: The difference between experienced and inexperienced auditors' cue selection performance will be larger in the analytical procedure risk task than in the control risk task.

Although extensive research has addressed the issue of cue weighting (see Libby 1981 for a review), very little research has investigated experience-related differences in cue weighting. Johnson et al. (1981) found that experienced clinicians agreed more about cue weights than did medical students. Slovic et al. (1972) documented such differences, but did not describe their nature.

Furthermore, the existing literature contains conflicting opinions on whether experience aids the judge in cue weighting. Some researchers hypothesize that experience is necessary for cue weighting. For example, Einhorn (1974) notes that agreement by experts is partly a matter of agreement on cue weighting and combination. Slovic (1969) notes that part of an experienced professional's success is due to his or her ability to weight cues differentially according to their relative importance.

There are others, though, who imply that experience is not necessary for superior performance in cue weighting. Shanteau (1984) suggests that, once given the relevant cues, inexperienced subjects may be able to act like experienced subjects. Dawes (1979) and Dawes and Corrigan (1974) suggest that experience is crucial only in the cue selection component. Some research also suggests that, when no criterion is available, equal weighting schemes may be optimal (e.g., Einhorn and Hogarth 1975); this would imply that knowledge gained through experience would not be necessary.

In accounting, Wright (1988) suggests that relative weighting of cues may depend on experience. Most researchers (e.g., Ashton 1974; Ashton and Brown 1980; Gaumnitz et al. 1982; Hamilton and Wright 1982; Abdolmohammadi and Wright 1987) have examined experience-related differences in cue weighting for internal control evaluations, and found few such differences. Nevertheless, results about the effects of experience on cue weighting are inconclusive. It is, therefore, difficult to hypothesize the effects of experience without considering the unique characteristics of the tasks to be studied.

In order to learn the relevant cues and their weights in the analytical risk task, the auditor needs experience performing analytical procedures, so that he or she may determine the diagnosticities of the various attributes (cues) of those procedures for detecting errors. To determine diagnosticities of cues and, consequently, their relative weights, he or she must have performed procedures in various situations over time. Although inexperienced auditors occasionally perform or assist with analytical procedures, they will not have experienced a wide variety of situations in which those procedures are performed. Furthermore, more experienced auditors usually hypothesize causes of these changes (Libby 1985), and evaluate those hypotheses based on evidence the inexperienced auditor may gather for them. As such, inexperienced auditors may have never received feedback on whether an error existed and, if so, which cues were most important in detecting the error and lowering analytical risk. The difference between experienced and inexperienced auditors' knowledge about cue weighting in analytical risk assessment should be fairly large. This suggests the following hypothesis:

> H2: The difference between experienced and inexperienced auditors' cue weighting performance will be larger in analytical procedure risk assessment than in control risk assessment.

The next sections describe the two experiments designed to examine experience effects in one aspect of cue selection and cue weighting.

Overview of Experimental Methods

Each experiment used a 2 × 2 design with two tasks (control risk assessment and analytical procedure risk assessment), and two experience levels of auditors.

Analysis of experience effects in each experiment was done by comparing the experienced auditor-inexperienced auditor performance difference in one task to that performance difference in the second task. The purpose of Experiment 1 was to determine how experience affects cue selection. The purpose of Experiment 2 was to determine how experience affects cue weighting. Participants in both experiments were inexperienced and experienced auditors from two national accounting firms[6] who were attending, respectively, second-year staff and manager training schools (see fn. 5).

In each experiment, subjects were randomly assigned to perform the control risk or analytical risk task. In each condition in Experiment 1, each auditor was presented with a booklet including instructions, background information, the knowledge test, and a postexperimental questionnaire. Subjects in Experiment 2 received the same background information, the judgment task, and a postexperimental questionnaire. Postexperimental questionnaires collected data on collegiate training, firm training, experience in assessment, and experience in reviewing others' assessments for control risk or analytical risk.

Subjects in both experiments received brief verbal instructions.[7] The experiments were administered during the training programs and subjects were not allowed to use reference materials or confer with one another. Subjects required about 10 minutes to complete Experiment 1 and 30 minutes to complete Experiment 2.

Experiment 1—Cue Selection

Subjects

In Experiment 1, participants were 38 inexperienced auditors, 25 from Firm 1 and 13 from Firm 2, with an average of 2.10 years of experience, and 28 experienced auditors, 12 from Firm 1 and 16 from Firm 2, with an average of 6.72 years of experience.

Method

To test for the effects of experience on cue selection, experience level and audit task were combined in a 2×2 factorial design. Subjects in each audit task condition received background information for a small manufacturing company, including a brief description of the company's size, ownership, and business. Following this were instructions describing and defining the risk assessments that were to be made during audit planning and an indication as to which risk assessment the subject was to consider.

Subjects then received lists of 16 cues, obtained from professional sources, that were relevant (targets) or irrelevant (distractors) to one of the two risk assessments. They were asked to circle either "yes" or "no" for each cue, to indicate whether they would or would not consider that factor to be relevant to the risk assessment in question. In the control risk condition, target (relevant) cues were controls over sales and receivables (Ernst and Whinney 1986; Robertson and Davis 1988, chap. 13), and distractor (irrelevant) cues were environmental considerations which would only affect the assessment of inherent risk for sales and receivables (Ernst and Whinney 1986; Dhar et al. 1988).[8] As an example, one target cue was "independent accounting for the serial order of billings." One distractor cue was "seasonality of sales." The Appendix contains the complete list of cues used in the control risk condition.

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[6] The firms are both in the medium range on the dimension of firm structure (Kinney 1986). They were chosen to be similar on that dimension so that firm structure could not account for any firm differences in results.

[7] In one administration of both experiments for a small number of experienced auditors from Firm 2, the researcher's verbal instructions were given by tape recording, not in person. The instructors who were present at that administration also reemphasized the instructions verbally.

In the analytical procedure risk task, target cues were factors that an auditor would consider in assessing analytical risk (Ernst and Whinney 1986; Guy and Alderman 1987; AICPA 1988). Distractor cues in the analytical risk condition were sampling attributes that are used to limit test of details risk (AICPA 1981). A sample target was "number of independent sources of data used to develop expectations for sales/receivables"; a distractor was "method of projecting sample error to population." The Appendix contains all cues used in this condition.[9]

In both treatments, distractor cues were selected from the same category of variables as the target cues. Targets and distractors in the control risk task were client-specific variables, whereas targets and distractors in the analytical procedure risk task were auditor choice variables. As a result, distractors differed across tasks. Although having constant distractors across tasks would have been desirable, the relation of distractors to targets would have then differed across tasks. In the control risk task, both targets and distractors would have been client-specific variables; while in the analytical risk task, targets would have been auditor variables and distractors would have been client-specific variables. Because it was not clear how these differing relations of targets and distractors might interact with experience, the sacrifice in internal validity from using different distractors was thought to be less than the sacrifice from using constant distractors. Furthermore, the use of distractors from the same category as targets was thought to be a better test of the effects of knowledge gained through experience. Inexperienced auditors might be able to distinguish between items from different categories simply on surface features of those items, e.g., wording which would indicate that the items were either client-specific or auditor variables. Knowledge acquired through experience should allow auditors to distinguish within categories based on more substantive features of the items (Chi et al. 1982).[10]

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[8] Although there are some factors which may be relevant to both control risk and inherent risk assessments, the cues used here were carefully chosen to be relevant to only one risk assessment.

[9] Pilot tests also verified the relevance of targets and the irrelevance of distractors. Participants in these pilot tests were experienced auditors at the two firms which participated in the study and at a third firm which did not participate.

[10] Subjects were not formally required to select the cues that they would use in making their judgments (cf. Abdel-khalik and El-Sheshai 1980), but instead classified them based on their relevance to the task. Knowledge of relevance is a necessary condition for proper cue selection. Though it appears unlikely, to the degree that subjects would not select cues judged to be relevant and would select those judged to be irrelevant, the results of this task would not generalize to cue selection. If this pattern emerged differentially across the two tasks, the conclusions would be improper.

Table 1
Experiment 1—Analysis of Variance: Firm × Experience Level × Task with Cue Selection Accuracy Scores as the Dependent Variable

Source	*Sum of Squares*	*df*	*Mean Square*	*F-statistic*	*Probability*
Firm	46.87	1	46.87	6.84	0.011
Experience Level	0.06	1	0.06	0.01	0.924
Task[1]	260.95	1	260.95	38.11	0.000
Firm × Level	15.55	1	15.55	2.27	0.137
Firm × Task	0.21	1	0.21	0.03	0.861
Level × Task	2.64	1	2.64	0.38	0.537
Firm × Level × Task	23.57	1	23.57	3.44	0.069
Error	397.18	58	6.85		

[1] Control Risk assessment and Analytical Procedure Risk assessment.

Results and Discussion

To test Hypothesis 1, a 2 × 2 × 2 ANOVA was estimated with firm, experience level, and task as between-subjects factors. The dependent variable for cue selection was an accuracy score, which was computed as the total number of targets for which "yes" was circled minus the number of distractors for which "yes" was circled, i.e., the number of targets answered correctly minus the number of distractors answered incorrectly. The maximum possible score, then, was eight, as there were eight targets and eight distractors (where the best possible performance was zero incorrect). That is, subjects were given credit for recognizing targets as being relevant. However, because distractors were from the same category of variables as targets and, thus, difficult to detect without appropriate knowledge, subjects were penalized for believing distractors to be relevant. This penalty is consistent with recognition performance measures used in psychology studies where the distractors were difficult to recognize (Gillund and Shiffrin 1984).[11]

Results of the analysis are presented in Table 1. As shown in Table 1, the existence of a marginally significant firm × level × task interaction required that the hypothesized level × task interaction be examined separately by firm. This ANOVA was run again to test for simple effects (level × task interactions) by firm. For Firm 1, the only effect was that accuracy scores were significantly different between tasks ($F = 21.28$; $p = 0.000$); this occurred because scores were higher in the control risk task than in the analytical procedure risk task, for both experienced and inexperienced auditors.

The analysis of simple effects for Firm 2 found the hypothesized interaction, i.e., the difference between experienced and inexperienced auditors' mean accuracy scores in analytical risk was significantly larger than the difference in control risk accuracy scores ($F = 2.91$; $p = 0.047$). Analyses of simple effects

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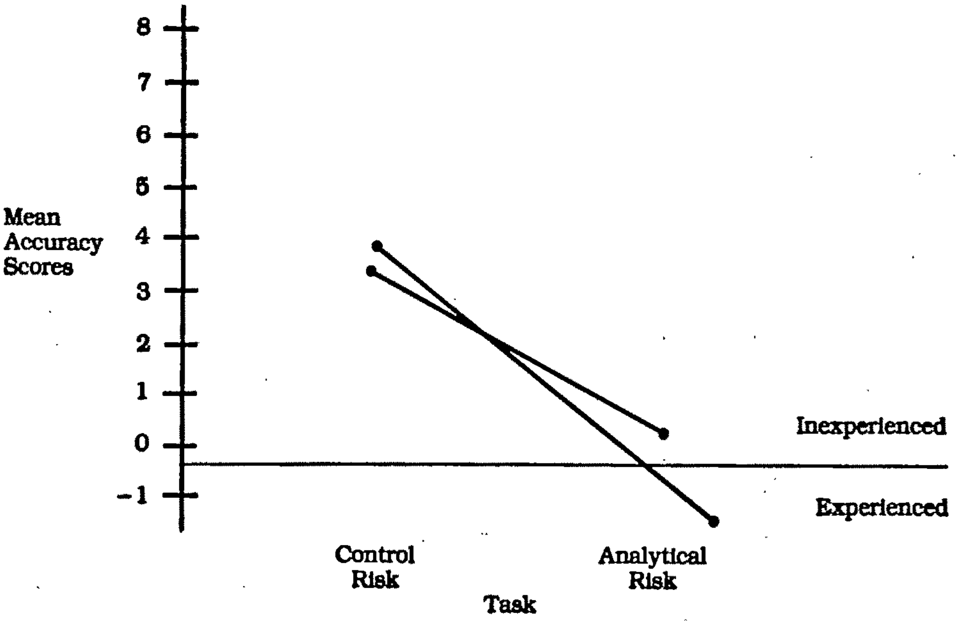
[11] Further, note that this accuracy score equally weights Type I and Type II errors, as the lack of a definitive relationship between these errors and audit effectiveness makes it difficult to specify the costs attached to each type of error.

Figure 1
Experiment 1—Mean Accuracy Scores for Firm 1 for Control Risk and Analytical Risk Cue Selection

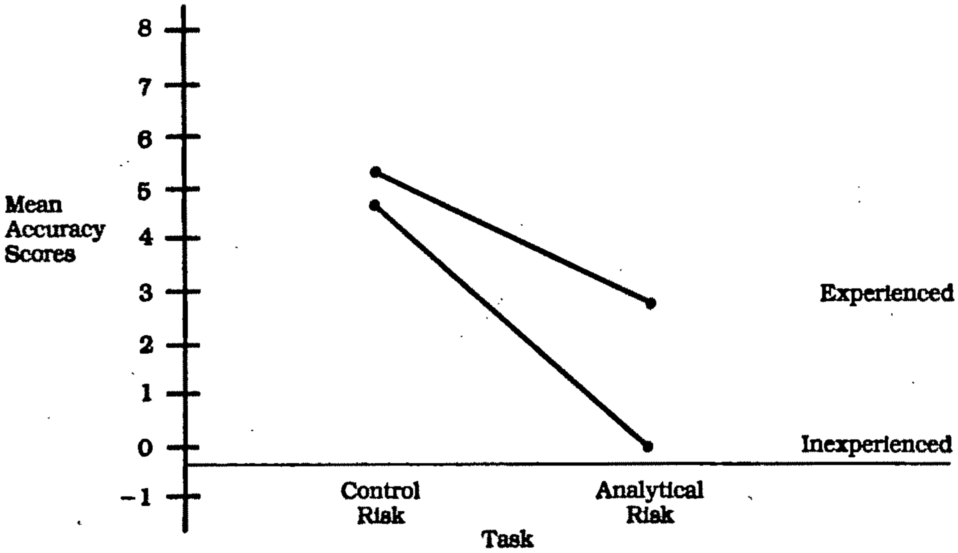


revealed that Firm 1's inexperienced and experienced auditors did not differ significantly in either control risk accuracy scores ($p=0.929$) or analytical risk scores ($p=0.203$). Firm 2's inexperienced and experienced auditors did not differ on control risk scores ($p=0.628$), but experienced auditors performed significantly better than inexperienced auditors on analytical risk scores ($p=0.008$), thus creating the experience level-task interaction for Firm 2. These firm differences are depicted in Figures 1 and 2.

Experienced auditors' accuracy scores were compared across firms, and simple effects were calculated for the control risk task and the analytical procedure risk task. Firm 2's experienced auditors performed significantly better than Firm 1's experienced auditors in analytical risk ($p=0.016$), but their performance in control risk was not significantly different ($p=0.325$). Firm 1 and Firm 2 inexperienced auditors did not differ on either analytical risk ($p=0.779$) or control risk ($p=0.130$) scores. The difference between Firm 1 and Firm 2, then, appears to have occurred only in the experienced auditors' performance in analytical risk. Furthermore, the difference in performance was due only to performance on the distractors. Firm 1's experienced auditors considered many more distractors to be relevant than did Firm 2's ($p=0.005$) but they performed equally well at recognizing targets as being relevant.

Hypothesis 1 was confirmed for Firm 2, but not for Firm 1. A review of the firms' audit manuals indicated that Firm 2 uses a form to assess analytical procedure risk, whereas Firm 1 does not. Firm 2 also has extensive instructions on

Figure 2
Experiment 1—Mean Accuracy Scores for Firm 2 for Control Risk and Analytical Risk Cue Selection



how to use this form, including which cues are relevant, to appropriately assess analytical risk, whereas Firm 1 has less extensive instructions in this area. Thus, results for Hypothesis 1 are consistent with the idea that training and experience in a task creates task-specific knowledge of relevant cues which can aid in cue selection.

Experiment 2—Cue Weighting

Subjects

Participants in Experiment 2 were 41 inexperienced auditors and 23 experienced auditors who did not take part in Experiment 1. The inexperienced auditors, 26 from Firm 1 and 15 from Firm 2, had an average of 1.91 years of experience; the experienced auditors, 8 from Firm 1 and 15 from Firm 2, had an average of 5.72 years of experience.

Method

To examine the effects of experience on cue weighting agreement, Experiment 2 used a 2×2 design. Experience level and task were between-subjects variables as in Experiment 1 (experienced auditor-inexperienced auditor and analytical risk-control risk). Each subject analyzed 16 cases for a single task (control risk or analytical procedure risk). The 16 cases represented a 1/2 replicate of a 2^5 orthogonal design.[12]

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[12] The eight relevant cues used in Experiment 1 were combined into five cues for Experiment 2. The combination was made to reduce the number of cases a subject had to complete, and because some

Each case contained five relevant cues. In both the control risk and analytical risk conditions, cues indicated either a value of "high level" or "low level" of the attribute of the control system or analytical procedure. Based on the five cues in each case, subjects made the appropriate risk assessment on a nine-point scale. The scales were labeled from "high risk" to "low risk." The postexperimental questionnaires were the same as in Experiment 1. As examples, one of the control risk cases and an analytical procedure risk case are shown in the Appendix.

Results and Discussion

Cue weighting agreement. To assess the effect of experience on cue weighting and the effect of cue weighting on judgment agreement, the social judgment theory version of the lens model was used (e.g., Hammond et al. 1975). This model assesses agreement between two judges as being a function of their agreement on cue weighting and each individual's consistency and configurality. The model is:

$$r_a = G \times R_1 \times R_2 + C(1-R_1)(1-R_2),$$

where:

r_a=correlation between subject 1 and 2's judgments (here, risk judgments),
G=correlation between predictions based on models of subject 1 and 2's judgments, or the "matching index,"
R_i=consistency of subject i in applying his or her judgment policy (from a linear regression of the subject's judgments on the five cues), and
C=correlation between the residuals from subject 1 and 2's models (configurality or some other form of nonlinearity).

Most audit judgment studies have computed r_a, which includes the effects of cue weighting, consistency, and configurality (Wright 1988). Since G represents agreement on cue weighting alone, it provides more information about experience effects in this component of global judgments.

A measure of agreement (consensus) is being used here as there is no criterion for accuracy of cue weights. Although some researchers suggest that consensus may be a poor surrogate for accuracy (e.g., Wright 1988), others believe consensus is a good measure of "expertise" (Shanteau 1984). In fact, Ashton (1985) found high correlations between consensus measures and accuracy measures in two accounting studies. Furthermore, as Libby (1981, 31) notes, "consensus judgments provide the backbone for much of accounting practice," since many accounting and auditing tasks have no objective criterion. Also, training and decision aids are designed to promote consensus, and consensus is an often used defense in litigation.

G was calculated for each pair of experienced auditors and each pair of inexperienced auditors within each task by estimating a linear regression of each subject's judgments on the five cues, then correlating each pair of predicted values

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of the cues were highly redundant. A 1/2 replicate was used here to prevent subject fatigue; however, interactions among cues were confounded with main effects. Since interactions among cues were not of interest here, the confounding of interactions did not affect either the dependent variables or the interaction between experience level and task, which was the effect of interest.

Table 2
Experiment 2—Analysis of Variance: Experience Level × Task with Matching Indexes (*G*, or Agreement on Cue Weighting) as the Dependent Variable

Source	*Sum of Squares*	*df*	*Mean Square*	*F-statistic*	*Probability*
Experience Level	3.60	1	3.60	13.84	0.000
Task	7.09	1	7.09	27.25	0.000
Level × Task	1.74	1	1.74	6.68	0.010
Error	134.40	517	0.26		

Cell Means

Experience Level	*Task*	*Mean*
Inexperienced	CR	0.468
Inexperienced	AR	0.201
Experienced	CR	0.735
Experienced	AR	0.743

CR = Control risk
AR = Analytical risk

from those regressions. These matching indexes were the dependent variables in a 2×2×2 ANOVA, where firm, experience level, and audit task were between-subjects factors. In this analysis, only within-firm *G*'s were used.

Since this ANOVA indicated that there was no firm × level × task interaction[13] ($p=0.874$) and since the hypothesis of interest was the level × task interaction, a 2×2 ANOVA was run with level and task as between-subjects factors and using all *G*'s, including both within-firm and across-firm *G*'s. The results are presented in Table 2. The level × task interaction occurred because the difference between experienced and inexperienced auditors' matching indexes was larger in the analytical risk task than in the control risk task ($p=0.010$).

In this analysis, then, Hypothesis 2 was confirmed, suggesting that experience provides better agreement for cue weighting in analytical risk assessment.[14] This result does not, however, lead to the conclusion that experience provides better agreement in the overall analytical risk assessment, as experience-related differences in consistency (R) or configurality (C) may offset experience-related cue weighting differences.

Effect of cue weighting agreement on judgment agreement. To assess the effect of cue weighting agreement on judgment agreement, r_a and C were calcu-

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[13] The absence of a firm effect here is consistent with the results for targets and distractors in Experiment 1. Experienced auditors performed equally well at identifying targets as relevant. As only targets are used in this experiment, no firm difference is expected.

[14] When asked to rank the eight relevant cues from Experiment 1, i.e., provide a surrogate for subjective cue weights, experienced and inexperienced auditors did not differ on ranking agreement in either task (Bonner 1988). These results are feasible since subjects are unable to provide subjective weights which correspond to their objective weights (e.g., Summers et al. 1970).

Table 3
Experiment 2—Mean Lens Model Statistics

	r_a[1]	G	R	C
Experienced—Analytical Risk	.634	.743	.928	−.055
Inexperienced—Analytical Risk	.171	.201	.874	−.019
Experienced—Control Risk	.655	.735	.909	.284
Inexperienced—Control Risk	.442	.468	.837	.099

[1] r_a=correlations based on subjects' risk judgments.
G=correlations based on subjects' models.
R=consistency of subjects in applying their own models.
C=correlations based on model residuals.

lated for each pair of experienced auditors and inexperienced auditors, within each task. R was also calculated for each of these subjects. The mean for each of these statistics, as well as G, is presented for each treatment in Table 3. As shown in Table 3, G and R accounted for most of the magnitude of r_a, as the term $C(1-R_1)(1-R_2)$ was quite small on average. This result is consistent with early studies of judgments which had criterion variables (e.g., Hammond et al. 1964); again, there is some evidence in accounting that consensus and accuracy are related (Ashton 1985).

To further explore the effects of the various components of the model on r_a, 2 × 2 ANOVAs were estimated with experience level and task as between-subjects factors for r_a, R, and C as dependent variables. The results are as follows. There was a significant level × task interaction for r_a ($p=0.002$), as well as for C ($p=0.001$). There were no significant effects for R ($p=0.781$). The level × task interaction for C could not have created the level × task interaction for r_a, as the experienced auditor-inexperienced auditor difference was larger in control risk (.185) than in analytical risk (−.036) and, as mentioned above, the term $C(1-R_1)(1-R_2)$ was very small on average. Similarly, the level × task interaction in r_a could not have been caused by experience-related differences in R's, as there were none. As such the level × task interaction in r_a, where the experienced auditor-inexperienced auditor difference in analytical risk r_a's (.463) was much larger than that in control risk (.213), was mainly caused by the differences in cue weighting agreement.

The expected experience effect in cue weighting was found and, further, in a lens model judgment task, cue weighting was the factor which most accounted for experience effects in the global judgment. This finding is consistent with some psychology results (e.g., Johnson et al. 1981) and not others (e.g., Dawes 1979). It is unclear, then, whether task-specific knowledge differences consistently aid the performance of experienced auditors in cue weighting, or whether they can interact with certain task characteristics to create no differences in performance. Further, it is unclear whether, in all tasks, there are task-specific knowledge differences (with regard to cue weighting) between experienced and inexperienced auditors.

General Discussion

The purposes of this study were to investigate the role of task-specific knowledge in experience effects in audit judgments and how that task-specific knowledge affects the performance of experienced auditors in certain components of those judgments. The study also attempted to examine certain methodological questions raised by previous studies of experience effects in auditing. Results showed that experience aided auditors from only one of two firms in acquiring knowledge of relevant cues for cue selection in analytical procedure risk assessment. This may be attributable to differences in firm training as the firms were chosen to be similar on the dimension of firm structure. Experience aided auditors from both firms in agreement on cue weights; further, experience-related differences in cue weighting were the primary determinants of experience-related differences in overall judgment. The latter result was demonstrated by use of the social judgment theory version of the lens model, previously unused in accounting research. These results suggest that training and decision aids may be useful for both cue selection and cue weighting.

This study has several limitations. In Experiment 1, only one aspect of cue selection, knowledge of cue relevance, was studied. As discussed above, results from the knowledge task may not generalize to a true cue selection task. Generalizing results from the audit tasks examined to other audit tasks can also be difficult, especially if both task characteristics and subject characteristics affect performance. Further, not all components of the tasks were studied here. There may be components in which knowledge gained through experience does not aid performance.

Auditors from other firms may possess different characteristics than the subjects studied here, e.g., task-specific knowledge. Further, knowledge differences and judgment differences were indirectly linked; a full program of expertise research requires more investigation of their direct relationship, with careful consideration of firm differences and their effect on such subject characteristics as task-specific knowledge.

Appendix

Selected Experimental Materials

Experiment 1—Control Risk Cues

1. Introduction of new products this year (D)
2. Separation of credit approval from order entry and bad debt writeoffs (T)
3. Support for return credits with receiving reports or other appropriate documents (T)
4. Effect of general economic conditions on customers of Southern Mills (D)
5. Frequent aging of accounts and follow-up on delinquent accounts (T)
6. Composition of Southern's board of directors (D)
7. Extent of centralization of production (D)
8. Independent accounting for the serial order of billings (T)
9. Independence of detail accounts receivable recordkeeping from billing and shipping (T)

10. Seasonality of sales (D)
11. Southern's policies on control of product quality (D)
12. Proper approval on discounts and returns before issuance of a credit memo (T)
13. Customer dependence on Southern Mills as a source of supply (D)
14. Number of foreign customers (D)
15. Proper support for sales orders with approved customer lists and price and discount schedules (T)
16. Reconciliation of billings to original sales or shipping documents (T)

(T) = Target, or relevant cue
(D) = Distractor, or irrelevant cue

Experiment 1—Analytical Risk Cues

1. Expected number of errors in sales/receivables populations (D)
2. Number of independent sources of data used to develop expectations for sales/receivables (T)
3. Size of differences from expectations to be investigated (T)
4. Allowable risk of incorrect rejection (D)
5. Sophistication of method used to convert data into predicted sales and receivables (T)
6. Method of projecting sample error to population (D)
7. Size of sample (D)
8. Thoroughness of investigation concerning unusual sales transactions (T)
9. Level of detail of data used to develop expectations for sales and receivables (T)
10. Type of sample selection technique to be used (D)
11. Relationship of sample to audit objective (D)
12. Independence of data used to develop expectations for sales and receivables (T)
13. Method of evaluating sample results (D)
14. Allowable risk of incorrect acceptance (D)
15. Amount of work to be done to establish reliability of data used for expectations (T)
16. Planned reliance on client explanations for differences vs. our audit tests (T)

(T) = Target, or relevant cue
(D) = Distractor, or irrelevant cue

Experiment 2—Example of Control Risk Task

	Attribute of Control System	*Level of Attribute*
(1)	Segregation of sales and receivables duties	High level of segregation
(2)	Support and approval for credits for returns	High level of support and approval
(3)	Frequency of aging of accounts and follow-up on delinquent accounts	High level of aging frequency
(4)	Approval and support for sales orders	Low level of approval and support
(5)	Support for billings and independent accounting for sequence	Low level of support and independent accounting

Rating of control risk:

1	2	3	4	5	6	7	8	9
High risk Low assurance								Low risk High assurance

Experiment 2—Example of Analytical Risk Task

	Attribute of Procedures	*Level of Attribute*
(1)	Independence of data sources used to develop expectations for sales and receivables	High level of independence
(2)	Amount of detail of data used to develop expectations	High (large) amount of detail
(3)	Sophistication of method used to convert data into expectations	High level of sophistication
(4)	Amount of work done to establish reliability of data	Low (small) amount of work
(5)	Planned amount of investigation of differences from expectations	Low level of investigation of differences

Rating of analytical risk:

1	2	3	4	5	6	7	8	9
High risk Low assurance								Low risk High assurance

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Equity Valuation and Corporate Control

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ABSTRACT: The proliferation of control contests for large public corporations at 50% + premiums above market illustrates the wide divergence between open-market stock prices and equity exchange values. This paper considers equity valuation in corporate control transactions—e.g., management buyouts and hostile takeovers—that engender potentially severe manager-stockholder conflicts. These conflicts generate a demand for independent assessments of equity values by investment bankers who specialize in these appraisals. The paper provides evidence from (1) a large sample of fairness opinions on management buyouts, and (2) a small sample of investment bankers' working papers which indicates that investment bankers' valuation techniques make extensive use of accounting data. This demand for accounting information in equity valuation is distinct from that previously recognized in the capital markets or contracting literatures.

EQUITY exchange values in corporate control transactions—e.g., mergers, tender offers, management buyouts, leveraged recapitalizations—routinely deviate substantially from open-market stock prices. For example, management buyouts of exchange-listed corporations typically occur at a 50% + premium above the pre-offer stock price (DeAngelo et al. 1984), as do interfirm tender offers (Comment and Jarrell 1987). Moreover, multiple bids for the same firm often differ substantially from each other, and open-market stock prices do not at each moment equal the highest current (or eventual winning) bid (Bradley 1980).

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How are equity exchange values determined? The answer is important because these values divide the gains from a change in corporate ownership between stockholders and other corporate claimants, hence they affect the feasibility of control transactions. The answer is empirically important, given the proliferation of takeovers of large public corporations at 50%+ premiums above market. Obviously, a target corporation's pre-offer stock price is an inadequate measure of its acquisition value. Perhaps less obviously, its post-offer stock price is also inadequate, given uncertainty about the outcome of the current bid, the price the current bidder is ultimately willing to pay, and the existence of other bidders and their possible offer terms. In short, capital market efficiency does not ensure that market prices perfectly reveal equity values in *each* feasible alternative use, and to each feasible alternative user.

The inability to rely on anonymous capital markets to value a given control transaction generates disagreement among stockholders over the exchange values of their claims. Since stockholders' cooperation is required to effect these transactions, such disagreement can potentially cause the failure of transactions that are overall value-increasing. This difficulty is exacerbated because equity exchange values can be negatively affected by the actions of managers who have (1) inside information about the value of target shares in alternative uses, and (2) interests that conflict with those of their stockholder constituents. Manager-stockholder conflicts are especially severe in management buyouts and in hostile takeover attempts that offer target stockholders a substantial premium, while potentially costing managers their jobs.

In this paper it is argued that managerial conflicts of interest in corporate control transactions generate a demand for an independent valuation of shares. The evidence presented indicates that the terms of management buyouts are evaluated by investment bankers whose valuation techniques predominantly rely on accounting information. For example, discounted cash flow techniques employed in practice use historical accounting relations to estimate future cash flows. By imposing impartial, external constraints on equity exchange values, an independent valuation helps ensure these values are perceived as "fair" by the outside stockholders whose cooperation is required to effect a control transaction.[1] This process facilitates transactions that increase overall firm value, yet that also generate manager-stockholder conflicts of interest.

Section I develops the demand for an independent valuation of shares. Section II describes the valuation process and generally accepted valuation techniques. Section III reports evidence from a large sample of management buyouts that investment bankers unanimously cite accounting information as influencing their evaluations of the terms of these transactions. Section IV reports evidence from detailed case studies of a small sample of investment bankers' working papers, recently required to be filed with the SEC for management buyouts, that virtually all valuation techniques used by investment bankers rely on accounting information. Section V provides a brief summary.

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[1] It is impossible to ascertain whether the primary motivation of participants in this valuation process is to estimate equity values, or simply to justify selected values to outside stockholders and the courts. In either case, accounting information affects equity values to the extent that it defines the feasible range of "fair" values. These issues are discussed in Section II.

I. The Demand for an Independent Valuation of Shares

Insider-managers of corporations with equity claims in place have some ability to take actions that reduce the value of outsiders' claims (Jensen and Meckling 1976). One such action is to issue or redeem equity at other than "intrinsic" value, given managers' superior information. Competitive capital markets imperfectly protect outside stockholders from these welfare-reducing transactions when information is costly (Myers and Majluf 1984). Stock prices reflect the *expected* value of managers' inside information, conditional on the proposed transaction. While expectations should be realized on average, the shares of a *given* firm will trade at other than intrinsic value. Thus, issuing and redeeming shares at market prices does not ensure "fair" treatment of all stockholders or resolve all intra-stockholder conflicts over share values.[2]

When a corporation originally sells shares to outsiders, the offer price will reflect investors' perceptions of managers' ability to effect welfare-reducing equity transactions. Hence, managers have incentives to contractually pre-commit to limit their discretion over the terms of these transactions. Such responses include corporate charter provisions that pre-specify permissible transactions, e.g., anti-greenmail provisions and preemptive rights that provide proportionate access to future equity issuances.[3] They also include valuation formulas for equity exchange terms, e.g., common stock redemption rights (so-called "poison pill" securities), conversion features for convertible preferred stock and debt, and fair price provisions that stipulate a minimum offer price in mergers with a substantial stockholder (Smith 1978).

Not all future circumstances are foreseeable, however, nor are all potential manager-stockholder conflicts amenable to resolution via simple *ex ante* numerical sharing rules. Moreover, the technology for resolving intra-claimant conflicts can change over time, such as via changes in the legal system. Unforeseen financial innovations—including a wide variety of corporate control transactions—can expand the set of feasible equity transactions. For example, hostile cash tender offers were first attempted in the 1960s. Management buyouts were a rare occurrence until the late 1970s, and only recently have financing innovations such as "junk" bonds made these buyouts feasible for the largest corporations. The first leveraged recapitalization was proposed in the 1980s.

Table 1 describes the major corporate control transactions and the managerial conflicts they generate. These conflicts are likely to be relatively mild in friendly acquisitions, especially those that involve multiple bidders with equal access to information about the target firm.[4] At the other end of the spectrum are management buyouts and hostile takeovers, in which managerial conflicts are

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[2] For open-market trades among anonymous individuals, a well-functioning capital market harmonizes the interests of all stockholders (H. DeAngelo 1981). Stockholder unanimity fails in the current case because managers with monopolistic access to firm-specific information can influence the terms of subsequent equity issuances and redemptions.

[3] Proportionate stock issuances and redemptions mitigate intra-stockholder conflicts by providing all stockholders with equal or "fair" access to the offer.

[4] A competitive auction is *not* sufficient to guarantee that target stockholders receive "fair" value for shares, however, except in the unlikely case that managers can (and do) costlessly reveal and credibly verify all relevant inside information to all potentially relevant bidders.

Table 1
Corporate Control Transactions and Managerial Conflicts of Interest

Arm's Length Acquisitions:

1. *Friendly merger or tender offer* in which target management negotiates the offer terms with one or more bidders. Managers have incentives to favor bidders that promise them the most lucrative future employment opportunities. Mergers require voting approval of target stockholders, convey judicial appraisal rights, and target managers virtually always provide an investment banker's fairness opinion. Tender offers are ratified by target stockholders' tendering decisions.
2. *Hostile tender offer* in which target management opposes the takeover attempt. Managers have incentives to resist external bids that they believe will cost them their jobs, at the loss of a premium payment to their stockholders. Managerial takeover resistance is virtually always justified by an investment banker's opinion that the offer price is inadequate.

Non-Arm's Length Acquisitions and Partial Acquisitions:

1. *Parent-subsidiary acquisition* in which parent management purchases the public (often, the minority) shares of a partially-owned subsidiary. Parent managers have incentives to propose offer terms that favor parent over subsidiary stockholders. These acquisitions generally require subsidiary stockholder approval, convey judicial appraisal rights, and parent managers virtually always provide an investment banker's opinion that the terms are fair to subsidiary stockholders. These acquisitions require extensive disclosure under SEC Rule 13e-3.
2. *Management or leveraged buyout* in which managers (perhaps with the help of third party equity investors) purchase all shares held by outsiders. As purchasers, managers have incentives to minimize the price paid, and these incentives conflict with their fiduciary duty to obtain the best terms for outside stockholders. The disclosure and procedural requirements are the same as for parent-subsidiary acquisitions.
3. *Leveraged recapitalization* in which managers cause the corporation to pay out substantial cash to stockholders that is financed with new borrowing. Managers have incentives to "front-end" load the cash portion of these offers to compete with a hostile bid. In general, recapitalizations require stockholder approval and are accompanied by an investment banker's fairness opinion.

potentially severe. In management buyouts, managers have a fiduciary duty to negotiate the best possible terms for stockholders, offset by incentives as purchasers to pay the lowest possible price. Moreover, managers have some ability to suppress favorable inside information in order to purchase shares at less than "fair" value.[5] Similar conflicts of interest characterize acquisitions of a subsidiary's publicly-traded stock by a parent corporation.

In non-arm's length acquisitions, the target's post-offer stock price reflects market expectations about insiders' valuations, but it does not fully *reveal* those valuations to outside stockholders. Critically, stock prices understate "fair" value because they reflect *all* publicly-available information, *including* managers' perceived ability to buy shares at "unfair" terms and to otherwise reduce outside stockholder welfare.[6] Similar difficulties plague a target's stock price during a hostile takeover attempt. Outside stockholders cannot rely on stock prices to indicate definitively whether they should tender because market prices will not fully reveal managers' inside valuation of shares, either as an independent entity or if auctioned to the highest bidder.

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[5] As a theoretical matter, there is no unique "fair" value for shares when a control transaction generates gains whose realization requires the cooperation of more than one claimant group—in this case, managers and outside stockholders. Rather, the manager-stockholder relation is a bilateral monopoly, for which no unique sharing rule for joint gains exists.

Even absent these information problems, the target's post-offer stock price will not fully reveal the market's evaluation of its acquisition value, given uncertainty about the success of the current bid, the price the current bidder is ultimately willing to pay, and the existence of other bidders and their offer terms. To see this latter difficulty, consider the post-offer market price as a probability-weighted average of the values expected to accrue to target stockholders under different outcomes:

$$P_M = \pi_A P_A + (1 - \pi_A) P_S \tag{1}$$

where:

P_M = the open-market stock price after an offer is announced, but before it expires,

π_A = the market-assessed probability the target will ultimately be acquired (by the current or another bidder),

P_A = the market's expectation of the ultimate acquisition price conditional on the current bid,[7] and

P_S = the post-offer expiration market price expected to obtain if the target remains independent, which capitalizes target stockholders' expected values under all other perceived outcomes.

Equation (1) reveals that, while the target's post-offer stock price *incorporates* the market's assessment of its ultimate acquisition value, P_A, it does not perfectly *reveal* that value to outsiders, who observe only P_M. Individuals cannot costlessly invert market prices, which are weighted averages of conditional expected values, to obtain *one* of the priced components. Such inversion requires knowledge of the market-assessed probabilities and stockholder values under *all* other priced outcomes. The very characteristic that makes open-market stock prices good trading prices (they incorporate all publicly-available information) makes them inadequate measures of acquisition values, i.e., makes them insufficient to themselves *determine* the terms at which corporate control will (or should) be exchanged.

The failure of market prices to perfectly reveal acquisition values implies that potential bidders must themselves formulate an offer price for shares—they cannot rely on the capital market to costlessly provide it. Similarly, outside stockholders and the board of directors must incur resource costs to evaluate that price—a service the market does not costlessly provide.[8] In other words, the parties to a control transaction cannot infer the relevant P_A (which can differ according to attributes of the bidder, as well as the target firm) from the target's open-market stock price. The function of the equity valuation process is to generate an independent estimate of the relevant value.

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[6] Lev (1988) discusses how investors' perceptions of the fairness of open-market trading prices determine their willingness to trade shares. The current paper argues that their perceptions of the fairness of future equity issuance and redemption terms determine their willingness to invest equity capital in public corporations. Both effects are likely to be important determinants of economically relevant variables, such as open-market stock prices, equity exchange values, and bid-ask spreads.

[7] Equation (1) is a simplification, since P_A is itself a weighted average of the target's acquisition value to various bidders, each of which may put target assets to different uses or effect different synergistic combinations of target and bidder assets.

This paper emphasizes the demand for accounting information in the process through which acquisition values are determined. It is not directly concerned with the effect of accounting information on open-market stock prices as in capital markets research (e.g., Beaver 1973, 1981; Lev 1988). Because stock prices aggregate *all* public information, accounting data can have a relatively small marginal impact on open-market prices. In contrast, acquisition values are neither directly observable nor invertible from open-market stock prices, so that accounting data can be relatively important in determining acquisition values. The role for accounting information discussed here is conceptually distinct from its role in determining open-market stock prices.[9]

II. The Equity Valuation Process

Managers of firms engaged in a wide variety of control transactions hire an independent investment banker to evaluate the fairness of the transaction to the firm's outside stockholders. An investment banker's fairness opinion is virtually always provided to target stockholders in arm's length and non-arm's length mergers, and in leveraged recapitalizations. Managers who resist a hostile bid typically rely on an investment banker's opinion that the offer terms are inadequate. In short, corporate control transactions motivate a target firm's internal governance system to provide an independent valuation of shares. The extent to which this valuation process (1) is itself fair, and (2) generates fair equity values, is subject to review by the judicial system and the SEC.[10]

Evaluating the fairness of a corporate control transaction is complex, since the gains from these transactions require the cooperation of multiple groups of corporate claimants. Akin to the usual analysis of bilateral monopoly, there is *no* one theoretically correct way to divide joint gains in these cases, hence no one "fair" price for shares. Moreover, while managers and investment bankers may claim that a given offer price represents fair value, their actual beliefs are not observable. One possibility is that these parties believe what they claim. Another is that investment bankers simply "rubber stamp" whatever equity values managers select. In this latter view, investment bankers judiciously manipulate elaborate financial models to generate numbers that rationalize managements' chosen equity values to public stockholders and the courts.

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[8] The shares originally sold to outsiders should be priced to reflect the expected resource costs of evaluating future control transactions. Because such price protection is *sunk* in future periods, it does not alter managers' *future* incentives to engage in welfare-reducing transactions. Hence, outsiders face ongoing evaluation costs, which managers have incentives to reduce by providing a governance process that helps ensure that outsiders receive fair value in corporate control transactions.

[9] Of course, these two perspectives are not mutually exclusive, but rather they are related via the specification in equation (1). In particular, to the extent that accounting information affects P_A, it has a feedback effect on P_M.

[10] The landmark *Smith v. Van Gorkom* (1985) case highlights the importance of an internal governance process that appears capable of generating fair value for stockholders. The Delaware court found the directors of Trans Union Corp. had breached their fiduciary duty by approving an arm's length merger, even though the offer price was at a 48 percent premium to market, without "formal analysis" of the offer price or an investment banker's fairness opinion (Fischel 1985).

Absent an ability to infer individuals' actual beliefs, this "excuse" motivation is not refutable. Hence, one cannot rule out the possibility that the primary function of the valuation process is to justify managerially-dictated terms to outsiders. It is, however, worth noting that this view is analogous to the assertion one sometimes hears that certified public accountants routinely "rubber stamp" whatever income figure management selects. In fact, the parallels between the investment banking and auditing professions are striking. Each certifies the fairness of managements' financial representations, each relies to some extent on data compiled by managers, and each has economic incentives to maintain a reputation for independence and quality work (L. DeAngelo 1981).[11] The economic benefits from that reputation give investment bankers and auditors incentives to avoid "rubber stamp" approvals of managerial representations.[12]

It is important to note that *whichever* motivation for an independent appraisal is the dominant one—whether the process generates a good faith estimate of fair value or simply justifies managerially-dictated terms—the valuation techniques used in this process affect real resource allocation, hence stockholder wealth. To see this point, consider the extreme case in which the *sole* motivation for an independent valuation is to justify equity values that are *entirely* chosen by other means. Even in this extreme scenario, the valuation information that justifies the selected exchange values to outside stockholders and the courts helps *determine* those values because it sets bounds on the feasible range of equity exchange values. Hence, the investment banker's valuation techniques affect stockholder wealth even if the valuation process simply serves as an elaborate "excuse" to justify managerially-imposed decisions.

Finally, the information used to determine equity exchange values need not be the same as that used to justify those values to outsiders who possess neither (1) managers' inside information about the firm's future prospects, nor (2) investment bankers' valuation expertise. Outsiders who lack these advantages rationally demand (and insiders will therefore supply) valuation data that incorporate well-understood, external constraints on managers' ability to disadvantage outside stockholders via the exchange values set on corporate equity.

Table 2 summarizes the major equity valuation techniques for corporate control transactions. A common element of the comparable firms (row 1) and comparable acquisitions (row 2) approaches is that both use historical pricing relations from a trading market in shares (companies). For example, comparable firms analysis mimics the capital market's pricing function for earnings or book value, while comparable acquisitions analysis mimics the control market's pric-

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[11] The differences are also striking. Investment bankers have no codified rules for gathering and evaluating the evidence that underlies their opinion. Nor do they prohibit contingent fees, which are both routine and substantial.

[12] Investment bankers do sometimes refuse to issue a fairness opinion. In the Fort Howard management buyout analyzed in Section IV, management's initial $50 offer was judged unfair by the banker representing the outside directors, and management subsequently raised the offer to $53.

Table 2
Alternative (Nonmarket) Valuation Approaches Used to Value Publicly-Traded Equity in Corporate Control Transactions

1. *Comparable firms approaches* that develop an average relation between open-market prices and accounting variables. The primary method is to capitalize the current firm's per-share earnings at an average price/earnings ratio for comparable publicly-traded firms. Market-to-book and market-to-sales ratios are also sometimes employed.
2. *Comparable acquisitions approaches* that develop an average relation between prior acquisition prices and open-market prices or accounting variables. The primary method is to multiply an acquisition target's pre-offer stock price by an average premium paid in comparable acquisitions of publicly-traded corporations.
3. *Discounted cash flow (DCF) analysis*, sometimes operationalized as the capitalization of forecasted earnings or dividends (these approaches are detailed in Brealey and Myers (1988) and Weston and Copeland (1986)).
4. *Asset-based approaches* that develop an estimate of company value based on the appraised value of its assets, e.g., liquidation value. Liquidation values are not used to value going concerns, although asset appraisals are sometimes used to value companies with material real estate and/or natural resource holdings.

Sources: Banks (1972, 1974), Brudney and Chirelstein (1974), Chazen (1981), Fischel (1983, 1985), Giuffra (1986), Greenhill (1977), Harris (1981), Herzel and Colling (1984), Lipton (1979), Rosenbloom (1981), and Saffer (1984).

ing function for entire companies. Courts in the important state of Delaware have typically relied on the former approach, and have only recently begun to accept the latter. Discounted cash flow (DCF) techniques (row 3) are commonly used by investment bankers, but have only recently become acceptable in court.[13] Asset valuations (row 4) are rarely used, primarily to value real estate or natural resource holdings.

On the surface, it is puzzling that DCF analysis is not the *sole* equity valuation technique, given its prominence in finance textbooks (e.g., Brealey and Myers 1988; Weston and Copeland 1986). One plausible explanation is that DCF-generated equity values are sensitive to the cash flow and discount rate assumptions of insider-managers. Thus, while DCF analysis may be useful in assessing equity values in a given use or to a given bidder, it is not a very credible means of convincing outside stockholders that those values are fair.

In practice, DCF techniques are largely *accounting*-based valuation approaches. First, DCF valuations use historical accounting relations to forecast future earnings, from which future cash flows are estimated. Second, the terminal values that typically constitute the majority of DCF-generated values are commonly estimated from projections of future earnings. Finally, investment bankers rely on historical accounting relations to evaluate the reasonableness of managerial earnings forecasts, a practice that appears designed to reduce the credibility problems with DCF analysis. These facts suggest that it is inappropriate to view DCF analysis as a *substitute* for accounting-based valuation methods, since it is itself largely an accounting method in practice.

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[13] In the landmark *Weinberger v. UOP* (1983) case, the Delaware court initially "rejected the plaintiff's discounted cash flow method of valuing UOP's stock as not corresponding with 'either logic or the existing law.'" The Delaware Supreme Court reversed upon appeal, paving the way for future acceptance of the DCF and comparable acquisitions approaches.

Several other aspects of the valuation process seem designed to protect outside stockholders from managerial opportunism. First, investment bankers' valuations rely to a large extent on publicly-available, objective and verifiable data, such as market prices, acquisition values, and accounting data. Managers would seem to have little discretion over market prices, while their discretion over accounting data is limited by impartial institutional and regulatory constraints, including GAAP. When investment bankers use managerial forecasts, they attempt to evaluate their reasonableness. Thus, much of the evidence underlying a fairness opinion is either outside managers' control or incorporates well-understood, external constraints on managers' ability to affect that evidence.

Second, while there may be debate about cash flow and discount rate assumptions, investment bankers use explicit valuation models that generate arguably objective, mechanical share values. Third, they use a number of such models. The use of multiple, semi-independent valuation techniques avoids reliance on any one imperfect (potentially biased) approach. It thereby reduces the likelihood that a given control transaction is welfare-reducing for outside stockholders. The output of this process is a set of valuation working papers that typically runs 100–300 pages, and that generates a range of values that underlies the investment banker's opinion. This opinion serves as one basis upon which the board of directors evaluates a proposed control transaction.

If outside stockholders are not satisfied that their firm's internal governance process and/or the equity values it generates are fair, they can seek redress in court. Because the courts are a costly means of resolving conflicts, all parties have incentives to settle their disputes privately. Whether or not the parties to a given transaction actually go to court, court-sanctioned valuation methods set bounds on the feasible exchange values. In other words, managers can reduce the resource costs of litigation by structuring the transaction and its terms to satisfy the relevant court's fairness tests.

Legally, managers have the right (in fact, the obligation) to resist external offers they evaluate as inadequate (Easterbrook and Fischel 1981). Directors can be held liable for breach of fiduciary duty if they fail to consider explicit valuation evidence before acting on a bid. This standard of care is usually satisfied by an investment banker's opinion that the offer is inadequate (Giuffra 1986, 124–125; Lipton 1979; McAtee 1977).

Stockholders who dissent to a management buyout can demand the court-appraised value of their shares. Before *Weinberger v. UOP* (1983), Delaware courts assessed fair value via a weighted average of pre-offer stock prices, net asset value, and the capitalized value of historical earnings (Fischel 1983; Banks 1972, 1974). Since *Weinberger*, Delaware courts can accept other valuation approaches, e.g., comparable acquisitions and DCF techniques.[14]

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[14] Delaware courts have recently held that, once a decision is made to sell the firm, the board has a duty to facilitate an auction (*MacAndrews & Forbes Holdings, Inc. v. Revlon, Inc.* 1986). An auction does not eliminate the demand for an independent equity valuation since outside stockholders cannot be sure that the information managers provide external bidders ensures the auction is "fair."

III. Equity Valuation in Management Buyouts: Some Preliminary Evidence

This section provides evidence on the valuation information cited as influencing investment bankers' fairness evaluations of management buyouts. The source documents are 60 fairness opinions from the DeAngelo (1986) sample of 64 buyout proposals for New York and American Stock Exchange firms. As detailed in DeAngelo (1986), the initial sample was obtained by direct inspection of *The Wall Street Journal* over the ten-year period 1973–1982. While proxy materials for 61 (95 percent) of the 64 buyout proposals reference a fairness opinion, one firm did not supply its text and, therefore, was dropped for this analysis.

Thirty-one of the 64 buyout proposals do not include third party equity investors. These non-leveraged buyouts tend to involve firms that are majority controlled by management—in the 31 non-leveraged buyouts, management owned a mean 50.1% (median, 51.7%) of the common stock. The potential for a majority owner to coerce the minority to accept an "unfair" acquisition proposal has led to the popular term "minority freezeout" for these buyouts.[15] Proxy materials for 28 proposals (90.3%) contain the text of a fairness opinion. Pre-offer managerial ownership averages 24.5% (median, 15.4%) for the 33 leveraged buyouts, and proxy materials for 32 (97.0%) contain the text of a fairness opinion.

Table 3 reports the information cited in the investment banker's fairness opinion and/or management's proxy discussion as influencing the buyout terms. Column (1) reports data for the 28 non-leveraged buyouts, and column (2) reports data for the 32 leveraged buyouts. For both subsamples, 100 percent of the proxy materials cite accounting information as influencing the banker's evaluation of the offer terms. The same percent cites open-market prices as influential. Prices paid in other acquisitions are also widely cited (64.3% of the non-leveraged, and 81.3% of the leveraged buyouts), as are managerial forecasts (67.9% and 62.5%, respectively). The latter are probably used in DCF analysis, which will also include some portion of the 17.9% (and 9.4%) incidence reported for cash flow analysis (the two categories most likely overlap).

Dividend capacity and asset appraisals are less frequently cited. For example, the firm's dividend capacity or past dividend record is referenced in 39.3% of the non-leveraged and 25.0% of the leveraged buyouts. Other influences on fairness opinions in leveraged buyouts are the buyout specialist's memo to investors, exchange values for other negotiated transactions in the firm's equity, and the results of the investment banker's attempt to "shop" the company. The latter is not cited in any of the non-leveraged buyouts, perhaps because of the high degree of managerial stock ownership in these firms.

The Table 3 evidence indicates that investment bankers unanimously cite accounting information as influencing their fairness evaluations of management buyouts. Unfortunately, the data do not indicate exactly *how* accounting information is used in equity valuation. However, the SEC has recently strongly encouraged firms contemplating a management buyout to file the valuation infor-

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[15] There is a very limited role for a competitive auction in these cases, since the majority owner often does not want to, and cannot be forced to sell its interest to another party.

Table 3
Valuation Evidence Cited as Influencing the Terms of a Management Buyout: 60 Management Buyouts (1973–1982) with Text of Investment Bankers' Fairness Opinions Published in Proxy Materials

	28 Non-Leveraged Buyouts with No Outside Equity Participants		*32 Leveraged Buyouts with Outside Equity Participants*	
	n	*Percent*	n	*Percent*
Accounting information	28	100.0	32	100.0
Open-market stock price	28	100.0	32	100.0
Prices paid in other acquisitions	18	64.3	26	81.3
Management forecasts	19	67.9	20	62.5
Cash flow analysis	5	17.9	3	9.4
Dividend history or capacity to pay	11	39.3	8	25.0
Asset appraisal	8	28.6	6	18.8
Buyout specialist's memo to investors	n/a	n/a	10	31.3
Actual or contemplated price of prior equity transaction	6	21.4	5	15.6
Banker's attempt to shop the company	0	0.0	8	25.0

mation presented to the board of directors by their financial advisers in their Schedule 13e-3 filings.[16] These documents, the investment banker's equivalent to the auditor's working papers, can be analyzed via a case study approach to shed light on the manner in which valuation methods incorporate accounting data.[17]

IV. Equity Valuation in Management Buyouts: A Closer Look

I obtained a list of 1988 Schedule 13e-3 filings from Disclosure and requested valuation information for six firms that are reasonably representative of recent buyouts, according to consultations with investment bankers. Disclosure was able to supply the relevant filings for three of these firms—Bell & Howell Com-

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[16] According to the SEC Office of Tender Offers, this valuation information has been included in firms' Schedule 13e-3 filings since 1987. According to Disclosure, firms sometimes receive confidentiality from the SEC so that this information is only available (at considerable delay and expense) under the Freedom of Information Act.

[17] The approach here is similar to the one used by Leftwich (1983) to analyze the role of accounting information in private debt agreements. Leftwich studies *Commentaries on Indentures*, which provides a menu of potential debt covenants, combined with detailed inspection of actual lending documents from five private lenders. I study a large sample of fairness opinions, combined with detailed inspection of four sets of investment bankers' working papers. The ability to generalize from such studies is, of course, limited (Leftwich 1983, 30–31).

Table 4
Valuation Techniques Used by Four Investment Bankers to Evaluate the Fairness of a Management Buyout According to Details of Rule 13e-3 Filings[a]

Valuation Approach	*Morgan Stanley*	*Salomon Bros.*	*Dillon Read*	*First Boston*
Comparable firms analysis	yes	yes	yes	yes
Comparable acquisitions analysis	yes	yes	yes	yes
Discounted cash flow analysis	yes	yes	yes[d]	yes
Asset appraisal	no	no	no	no
Investment banker's attempt to shop the company	yes[b]	yes	no	no
Dividend history or capacity to pay	no	no	no	yes
Leveraged buyout model	no	yes	yes	yes
Leveraged recapitalization model	no	yes[c]	no	yes

[a] These filings are for the proposed 1988 management buyouts of Bell & Howell Company (investment bankers, Morgan Stanley and Salomon Bros.), Foodmaker, Inc. (Dillon Read), and Fort Howard Corporation (First Boston).

[b] Morgan Stanley did not itself shop the company, but its opinion refers to the Salomon Bros. attempt to solicit other offers.

[c] Salomon Bros. had performed this analysis for management before any external bidder made its intentions public.

[d] Dillon Read cautions that DCF analysis is of limited usefulness in leveraged acquisitions because of the sensitivity of its results to changes in its assumptions.

pany, Foodmaker, Inc., and Fort Howard Corporation.[18] Managers of all three companies proposed a buyout in 1988 and all have since gone private. Their filings contain fairness opinions with valuation documentation from four different "blue chip" investment bankers. Foodmaker and Fort Howard each provide one fairness opinion, and Bell & Howell provides two opinions.[19]

This section's case study analysis is, therefore, based on four sets of valuation documents—Morgan Stanley's and Salomon Brothers' reports on the Bell & Howell management buyout, Dillon Read's report on the Foodmaker buyout, and First Boston's on the Fort Howard Corp. buyout. These documents range from 92 to 309 pages in length, and detailed tables of numbers and sensitivity analyses comprise most of that length. I also rely on the investment banker's discussion of the factors that influenced the fairness evaluation, contained in the proxy statement or offering document, and on the fairness opinion itself. The Appendix reproduces Morgan Stanley's fairness opinion on the Bell & Howell management buyout.

Table 4 categorizes the valuation approaches used by each investment banker, according to my reading of these source documents. These materials exhibit the wide range of valuation techniques and sensitivity analyses that underlie a fairness opinion. The table cannot convey the large volume of financial data that support these opinions. It does, however, report the major approaches taken by the four investment bankers to highlight their differences and similarities.

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[18] The three firms for which I was unable to obtain valuation data are Jewelcor Inc., Plantronics Inc., and Trans World Airlines Inc.

[19] The first opinion is from management's investment banker, while the second is from the financial adviser to the special committee of outside directors that evaluated management's proposal. Such committees are typically formed to negotiate with management on behalf of outside stockholders. See DeAngelo and DeAngelo (1987) for a comprehensive discussion of the extensive checks on the manager-outside stockholder bargaining process in management buyouts.

With respect to the latter, all four investment bankers provide analyses of comparable firms, comparable acquisitions, and DCF analyses. As detailed below for the Fort Howard management buyout, all these valuation approaches (*including* DCF techniques) rely heavily on published accounting information. None of the investment bankers performs or relies upon direct asset appraisals.

Both investment bankers that evaluated the Bell & Howell management buyout acknowledge the Salomon Bros. attempt to solicit competing acquisition proposals in their fairness opinions (see Morgan Stanley's opinion, reproduced in the Appendix). The directors of the other two firms had not actively solicited competing bids at the time the fairness opinion was issued, and both investment bankers cite that fact in their opinions.[20] The observation that all four bankers' opinions discuss the solicitation of competing bids highlights the importance placed by courts in recent years on whether the directors held an open auction for the company. To some degree, a competitive auction substitutes for the valuation process discussed here, but not completely (see fns. 4 and 14).

Table 4 indicates that First Boston is the only banker to use a dividends capitalization approach. They use it to estimate stock prices if the company were to remain publicly-traded. Three bankers perform a leveraged buyout analysis and two also estimate equity values under a leveraged recapitalization. Leveraged buyout models assess financial feasibility under various assumptions about the offer price, proceeds from asset dispositions, and financing terms. The general approach is to project net income under various scenarios. Interest coverage ratios are then calculated, based on both earnings and cash flows, to assess financial risk. Returns to equity investors are also computed, and their sensitivity assessed to changes in underlying assumptions.

Table 5 reports the summary valuation of one investment banker to give readers a better feel for (1) the range of equity values generated by the valuation process, and (2) specific valuation techniques. First Boston's summary valuation of Fort Howard Corp. reports a preliminary price range of $35–62 per share, obtained from nine different valuation approaches (management's offer was $53 per share). They provide two DCF analyses of the entire firm. The first relies on management's long-run projections, while the second incorporates First Boston's adjustments to those projections (the "upside case"). The upside scenario assumes higher product prices, sales growth, and operating profit margins than do management's long-run projections.

Terminal values typically constitute a large portion of DCF-generated values. Consequently, investment bankers typically use several approaches to estimate

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[20] Dillon Read's opinion on the Foodmaker management buyout states that "the Agreement and Plan of Merger does not prohibit the Special Committee from soliciting competing proposals, and the Special Committee has advised us that it intends to request us to do so." First Boston's opinion on the Fort Howard management buyout states that "We were not requested to, and did not, solicit third party indications of interest in acquiring all or any part of the Company."

Table 5

Summary Valuation for the 1988 Management Buyout of Fort Howard Corporation: Prepared by The First Boston Corporation

Valuation Approach	*Preliminary Range Per Share*[1]
1. Consolidated DCF analysis[2]—Base case (management's long-range plan)	$49–$54
2. Consolidated DCF analysis[2]—Upside case (First Boston adjustments to managerial projections)	57– 62
3. Break-up value[3]	46– 57
4. Comparable company analysis	45– 53
5. Comparable acquisition analysis	38– 46
6. Dividend discount model	50– 60
7. Historical multiples	35– 50
8. LBO analysis	50– 54
9. Recapitalization analysis	49– 54

Sources: Exhibits (b)(4) and (d)(1) to the Schedule 13e-3 filing of Fort Howard Corporation dated July 1, 1988.

[1] The price at which the company went private in 1988 was $53 per share.

[2] Derived by estimating terminal values as multiples of 14–16 times 1998 projected unlevered net income and using a 12.0% discount rate.

[3] Derived using DCF and comparable publicly-traded company analyses for each of the four business segments, and comparable acquisition analysis for the two segments for which acquisition data were available.

these values. For the Fort Howard buyout, First Boston used three methods to estimate terminal values—a multiple of 1998 unlevered income, a multiple of 1998 book value, and a perpetual growth model applied to 1998 cash flows. As an example of the impact of terminal value assumptions on DCF equity values, First Boston's terminal value estimates constitute (1) 53–71 percent of equity values when estimated as a multiple of earnings, (2) 56–73 percent of equity values when estimated as a multiple of book value, and (3) 53–80 percent of equity values using a perpetual growth model.

Table 5 reports equity values of $49–62 from First Boston's DCF analysis, assuming terminal values of 14–16 times 1998 projected unlevered net income and a 12 percent discount rate. This range widens to $39–133 under the full set of assumptions considered by First Boston. First Boston points out in the offer materials that this wide range of values "demonstrates the sensitivity of discounted cash flow analysis" to terminal value assumptions and expresses a preference for the earnings multiple approach.[21]

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[21] First Boston is not the only investment banker to cite the limitations of DCF analysis. The offer materials for the Foodmaker buyout report that "Dillon Read indicated that it regarded the discounted cash flow analysis as less useful in this instance, because the company is highly leveraged and small changes in certain assumptions can produce large changes in per share values."

First Boston's $46–57 estimate of Fort Howard's break-up value is derived from DCF and comparable company analyses of each of the company's four major segments, and from comparable acquisition analysis of the two segments for which acquisition data were available. As noted in Table 5, First Boston also uses comparable company and comparable acquisition techniques on the entire firm. Company-wide comparable firm analysis generates equity values of $45–53, while First Boston's analysis of historical multiples generates values of $35–50. Their valuation working papers use data on the price/sales, price/cash flow, price/operating income, price/earnings, and price/book value multiples of Fort Howard compared to those of Scott Paper Company, James River Corp., and Kimberly-Clark Corp. These are clearly accounting-based valuation approaches.

First Boston also performs extensive additional analyses on the P/E ratios of Fort Howard compared to those of Scott Paper, James River, and Kimberly-Clark, and to the P/E ratios of 11 other paper companies that they deem less comparable. These analyses consider market prices and P/E ratios both before and after the October 1987 market crash. They use both historical EPS figures (as of June 30 and December 31, 1987) and the average Institutional Brokers' Estimate System (I/B/E/S) earnings forecast. First Boston also compares Fort Howard's monthly and quarterly P/E multiples since 1983 to averages for the Standard & Poor 400, using both actual earnings and I/B/E/S forecasts. These analyses generate a range of P/E (and price-to-book) multiples that First Boston applies to Fort Howard's projected EPS and book values to estimate equity values.

First Boston's comparable acquisition analysis describes the attributes of nine acquisitions of (and by) companies in the paper industry. These attributes are not acquisition premiums—rather they all relate acquisition values to various accounting variables. Specifically, First Boston reports acquisition values as a multiple of the latest 12-month net income, book value, sales, operating income, and operating cash flow. They also summarize attributes of completed tender offers in 1988 (as of May 1988), partitioned into hostile and friendly offers. These attributes include acquisition premiums—measured relative to market prices one day, one week, and four weeks prior to announcement. They also include acquisition values as a multiple of accounting variables—the latest 12-month sales, net income, and book value.

First Boston uses a "dividend discount" model to estimate the trading value of the company, should it remain public in substantially unchanged form. Despite the "dividend discount" label, this approach in essence capitalizes future *earnings*. Future dividends are assumed to be 40 percent of earnings projections for five years, and terminal value is a multiple of 1992 earnings.[22] Earnings projections are based on (1) management's long-run plan, and (2) First Boston's upside case. First Boston estimates trading values as the present value of expected dividends and terminal values under various discount rates. They also estimate trading values should the firm engage in a leveraged recapitalization.

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[22] Dillon Read takes a similar approach to estimate the trading value of Foodmaker equity in substantially unchanged form. (Foodmaker paid no dividends as a public company.) Dillon Read estimates equity value in 1993 as a multiple of terminal earnings, assuming managers' earnings projections are realized, and discounts that value using various required rates of return on equity.

Finally, First Boston performs a leveraged buyout analysis of the company (under various assumptions about offer prices, proceeds from future asset sales, and financial terms) to assess the financial feasibility of the proposed transaction. Their general approach is to project future earnings based on (1) management's long-range plan, (2) management's projections, assuming divestiture of certain assets, and (3) First Boston's upside scenario. Table 5 reports a range of $50–54 which is based on *assumed*, not derived equity values under this approach. First Boston's leveraged buyout analysis leads them to conclude that $54 is at the upper range of financial feasibility, and the offer materials report their opinion that "in light of the corresponding financial projections, it would be difficult to finance a leveraged buyout at higher prices."

The available evidence does not allow determination of the precise effect of a given valuation method on the final transaction price of $53 per share paid for Fort Howard equity. However, it does appear that $53 falls in the approximate mid-range of equity values generated by First Boston. Specifically, $53 lies within the range of values generated by six (two-thirds) of the nine valuation methods summarized in Table 5. Importantly, it lies below the range only for DCF-generated values in the upside case (and above the range implied by comparable acquisitions and historical multiples). In short, it appears that the ultimate transaction price is constrained to fall within the approximate range of values implied by a broad variety of valuation techniques.

Overall, accounting information and accounting statement formats—balance sheets, income statements, analysis of funds flows—permeate investment bankers' valuation techniques. Importantly, their use of accounting data is not confined to analysis of historical P/E or market-to-book multiples. Rather, accounting variables and relations are used in *every* valuation technique documented here. They are used in DCF analysis to evaluate managers' earnings projections and to estimate the terminal values that commonly drive DCF values. They are used to evaluate cash flow forecasts for leveraged buyout and leveraged recapitalization analyses, and in dividend and equity valuation models. They are used in comparable acquisition analysis to link acquisition values to firm-specific attributes. In fact, the equity valuation process can be reasonably characterized as one that predominantly employs accounting information to estimate fair compensation to outside stockholders.

V. Summary

The proliferation of control contests for large public corporations at 50%+ premiums above market illustrates the wide divergence between open-market stock prices and equity exchange values. This paper considers equity valuation in corporate control transactions—e.g., management buyouts and hostile takeovers—that engender potentially severe managerial conflicts of interest. These conflicts generate a demand for independent assessments of equity values by investment bankers who specialize in these appraisals. The paper provides evidence on the valuation information used by investment bankers to evaluate the fairness of a large sample of management buyouts. It also provides a closer look at their valuation techniques via a detailed case study of investment bankers' valuation working papers.

This evidence indicates that accounting information permeates the valuation process for management buyouts. It is, therefore, consistent with the hypothesis that accounting information affects real resource allocation, hence stockholder wealth, via the terms of corporate control transactions. Importantly, this inference holds whether the valuation process documented here is actually used to estimate equity exchange values, or whether it serves primarily to justify values selected via other means to public stockholders and the courts. The evidence also suggests that accounting information may affect equity valuation in other control transactions—e.g., hostile tender offers and leveraged recapitalizations—that represent promising areas for future research.

Finally, the analysis suggests that accounting information plays a more extensive role in the governance of manager-stockholder relations than previously recognized in the contracting or capital markets literatures. Specifically, it isolates a potentially important demand for accounting information beyond that associated with managerial wage agreements, debt contracts, and the political process (Watts and Zimmerman 1986). Moreover, the demand for accounting data in equity valuation is conceptually distinct from that posited in the capital markets literature, which restricts attention to open-market stock prices. In short, the role of accounting information in equity valuation (and corporate governance) is broader than previously thought.

Appendix

Morgan Stanley & Co. Incorporated
1251 Avenue of the Americas
New York, New York 10020

December 14, 1987

Special Committee of the
Board of Directors
Bell & Howell Company
5215 Old Orchard Road
Skokie, Illinois 60077-1076

Dear Sirs and Madam:

We understand that Bell & Howell Company ("Bell & Howell" or the "Company") is entering into a Merger Agreement, dated December 14, 1987 (the "Merger Agreement"), with BHW Acquisition Corp. ("Parent"), a Delaware corporation formed and controlled by a group of investors led by Robert M. Bass Group, Inc. and including certain members of the Company's management (the "Bass Group"), and BHW Merger Corp. ("Merger Sub"), a Delaware corporation and a directly or indirectly wholly-owned subsidiary of Parent. Pursuant to the Merger Agreement, on the terms and subject to the conditions thereof, Merger Sub will be merged with and into the Company (the "Merger"), and each then outstanding share of the Company's Common Stock, without par value (the "Common Shares") and each then outstanding share of the Company's Cumulative Convertible Preferred Stock, Series A, without par value (the "Preferred Shares" and collectively with the Common Shares, the "Shares"), other than Shares owned by Parent, Merger Sub, any other direct or indirect subsidiary of Parent and Shares held by stockholders of the Company who properly exercise any appraisal rights available under applicable law, will be converted in the Merger into the right to receive $64 in cash (the "Merger Consideration").

You have asked for our opinion as to whether the Merger Consideration to be received by the holders of Shares is fair to such holders (other than Parent and its affiliates) from a financial point of view.

For the purposes of this opinion we have, among other things,

(i) reviewed the audited and unaudited financial statements for the three most recent fiscal years and interim periods to date and certain other financial and operating data relating to Bell & Howell made available to us by Bell & Howell;

(ii) analyzed certain internal financial and operating data of Bell & Howell, including financial projections for the period 1987–1997 prepared by Bell & Howell management relating to the earnings, cash flow, assets, and prospects of the Company's business;

(iii) conducted discussions with members of senior management of Bell & Howell and its subsidiaries with respect to the Company's business, operating performance, and prospects;

(iv) reviewed the financial terms, to the extent publicly available, of certain recent acquisition transactions deemed relevant;

(v) compared the financial information relating to certain of the Company's businesses with published financial information concerning certain companies whose businesses we deemed to be comparable, in whole or in part, to those of the Company;

(vi) analyzed the market price and trading characteristics of Bell & Howell common stock for recent periods to date;

(vii) reviewed the Certificate of Designation relating to the Preferred Stock;

(viii) reviewed the Merger Agreement; and

(ix) performed such other analyses and examinations and conducted such other discussions as we have deemed appropriate.

In preparing our opinion, we have relied upon the accuracy and completeness of all information supplied or otherwise made available to us by Bell & Howell, and we have not independently verified such information or made or obtained an independent evaluation or appraisal of the Company's business. We have also assumed that the Company's projections have been reasonably prepared, and have been generated on bases reflecting the best currently available estimates and judgments of the future financial performance of the Company's business segments. We have relied on your counsel with respect to legal matters relating to the Merger Agreement and the transactions contemplated thereby. It should be noted that our opinion is necessarily based upon market conditions prevailing, and other circumstances and conditions existing at the present time.

As you know, we have been retained, and have received a fee therefor, solely for the purpose of rendering to you our opinion as to the fairness, from a financial viewpoint, of the consideration to be received by the Company's stockholders (other than Parent and its affiliates) pursuant to the Merger Agreement. Accordingly, we were not requested to solicit, and did not solicit, other potential purchasers for the Company or any of its business segments. Nor have we participated in any of the discussions or negotiations with the Bass Group or any other potential purchasers of the Company or any of its business segments with respect to the Merger Agreement or other possible alternative transactions. We understand that Salomon Brothers Inc. conducted a solicitation of acquisition proposals for the Company during November-December 1987, and we have discussed the results of such solicitation with Salomon Brothers Inc.

As we have advised you, in the past we have rendered financial advisory and investment banking services to Robert M. Bass Group, Inc. and certain affiliated entities (in matters not relating to the Company) for which we have received customary compensation.

Based upon the foregoing, and such other factors as we deem relevant, including our assessment of general economic, market, and monetary conditions, we are of the opinion that the Merger Consideration to be received by the holders of Shares is fair to such holders (other than Parent and its affiliates) from a financial point of view.

Very truly yours,

MORGAN STANLEY & CO. INCORPORATED

By; ______________________________

Steven Rattner
Managing Director

(Source: proxy statement dated April 16, 1988 for Bell & Howell Company)

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Economic Sufficiency and Statistical Sufficiency in the Aggregation of Accounting Signals

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ABSTRACT: Management accountants are often required to construct measures of performance of individual managers by aggregating several accounting numbers (signals). We show that the same method of aggregation will rarely be used for evaluating the performance of different managers. Instead, the method of aggregation will vary with the specific preference functions of individual managers and the corresponding action choices induced by the owner. Such an optimal aggregate always exists but is not, in general, a sufficient statistic for the individual signals with respect to the agent's effort. We further show that, in most cases, using all the information in the sufficient statistic makes the principal strictly worse off. The analysis provides insights into a different statistical approach for evaluating nonsufficient aggregates based on the signal to noise ratio of the individual signals that are aggregated.

MANAGEMENT accountants are often required to construct measures of the performance of individual managers by aggregating several different accounting numbers. A constructed aggregate is efficient if the reporting of the basic measures, in addition, does not provide valuable information in evaluating performance and determining incentive compensation for the manager.

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Baiman and Demski (1980a) suggest the use of Holmström's (1979) result from agency theory to evaluate the adequacy of aggregation. Holmström's result implies that the basic signals produce no incremental benefits if, and only if, the aggregate is a sufficient statistic for the signals with respect to the manager's effort. This result seems particularly useful because it evaluates aggregation based only on the information structure and not on the utility function of the manager. In this paper, we show that utility independent aggregation is not true in general; the optimal way of aggregating the basic measures depends on the individual manager.

Aggregation is the process whereby two or more different signals are combined, for example, by taking a weighted sum of the signals, to yield a single measure to evaluate the performance of a manager. The manager's compensation is then based on this aggregated measure. In the case of a manager responsible for controlling labor and material costs, the question of interest to the management accountant is whether a particular aggregate of the two costs is adequate as a performance evaluation measure. Such a measure should provide the manager with the appropriate incentives to work hard at controlling costs by reflecting the effect of a manager's actions. For financial accounting purposes, the two costs are aggregated by simply adding them together, but for performance evaluation purposes, more general forms of aggregation are often used. For instance, where the weighted sum of the two costs are taken, as in management by objectives,[1] greater weight is put on the cost category that the manager can influence. The focus of our paper is this more general aggregation for performance evaluation purposes.

While Holmström's (1979) result provides broad insights into the construction of utility independent aggregates by management accountants, it is valid only under Holmström's technical assumption that the probability distributions of the individual performance measures satisfy the so-called "all a or no a" condition.[2] Although this condition is expressed only in a technical and abstract form, it is clearly important to evaluate and assess when the "all a or no a" condition is valid because some powerful results obtain when it does hold. Furthermore, little is known about the adequacy of aggregate performance evaluation measures when the "all a or no a" condition is not valid.

We consider a broad class of distribution functions that includes distribution functions that have commonly been considered in agency theory in accounting. For this class, we show that the sufficient statistic criterion is applicable and utility independent aggregation obtains only when the "all a or no a" condition holds. Thus, the "all a or no a" condition is not only sufficient but also necessary for utility independent aggregation. That is, utility independence is driven entirely by the "all a or no a" condition. Within the broad class of density functions that we consider, we find that the condition will hold in very coincidental situations.

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[1] Under management by objectives, various goals and subgoals are negotiated and measured. The agent's performance is then evaluated as some weighted average of the individual measures.

[2] Baiman and Demski (1980a, 1980b) examine when the reporting of detailed variance information in addition to the aggregate is valuable. They find that reporting of the detailed variance information y (or z) is valuable if, and only if, the aggregate α is not a sufficient statistic for y (or z) with respect to the manager's effort a.

The implication of this finding and of Holmström's result is that it will not be possible to find utility independent aggregates. We show, however, that in the more likely cases outside the "all a or no a" subclass, it is still possible to construct an aggregate which is optimal for a particular manager even though it is not a sufficient statistic. The optimal aggregate will depend on the specific skill and risk attitudes of the manager, the goals of the firm, and the characteristics of the environment and available signals. This is in keeping with the wide latitude allowed and practiced in management control systems with regard to performance evaluation measures of individual managers.[3] In fact, we show that if all the information in a sufficient statistic is used in compensating the manager, the principal would be strictly worse off. This suggests that aggregation for optimal contracting is likely to be far more pervasive than that implied by the sufficient statistic criterion.

The analysis indicates that it is too much to ask for accounting systems for performance evaluation to be structured independent of the preferences and risk attitudes of individual managers. In particular, we draw on Banker and Datar (1989) to show how the characteristics of sensitivity and precision can be used on a case by case basis to evaluate when reporting of the detailed signals, in addition to an aggregate, will be valuable in monitoring the manager's effort.

The paper is structured as follows. Section I describes the basic model. Section II proves the equivalence of the "all a or no a" condition and utility independent aggregation and relates them to distribution parameters. Section III uses the characteristics of sensitivity and precision to evaluate the plausibility of the "all a or no a" condition. Section IV shows that the principal is strictly worse off if he or she uses additional information in a sufficient statistic not found in the optimal aggregate. Section V provides a numerical example and Section VI concludes the paper.

I. The Basic Model

We model a principal-agent relation as a two-person, single-period game, in which the principal wants to motivate and evaluate an agent. The agent chooses some effort (action) level $a \epsilon [\underline{a}, \bar{a}] \subseteq R$, which together with a random unobserved state of nature θ generates two accounting signals, y and z. Thus, $y = y(a, \theta) \epsilon Y \subseteq R$ and $z = z(a, \theta) \epsilon Z \subseteq R$. The effort choice of the agent is not observable by the principal, but y and z provide the principal with signals on the agent's effort. The actual monetary outcome to the agency is denoted by n, which is measured in terms of the accounting signals y and z by a known function[4] $n = n(y, z) \epsilon X \subseteq R$. The agent's compensation ϕ will be based on the jointly observed accounting signals y and z; that is $\phi: Y \times Z \rightarrow R$, and the residual $n(y, z) - \phi(y, z)$ accrues to the principal.

---

[3] This point is of critical importance to our development. Although institutional requirements such as GAAP dictate external reporting, no such restrictions hold for managerial performance measures in a management control system. The form and content of the aggregation may vary even within firms. For instance two cost centers, one which has significant labor costs and the other which has significant material costs will likely put different weights on material and labor in evaluating the two cost center managers. In fact, Horngren and Foster (1987, 885) advocate a system that takes into account the skill and risk-attitude of the manager and the goals of the firm in designing measures of performance.

[4] More generally, n can be modeled as a stochastic function of y and z as in Mirrlees (1976), Gjesdal (1982), and Banker et al. (1988).

The principal's utility function is assumed to be $W(n-\phi)$, with $W'(\cdot)>0$ and $W''(\cdot)\leq 0$. The agent is assumed to be strictly risk and work averse with a separable, twice continuously differentiable utility function $U(\phi)-V(a)$ with $U'(\cdot)>0$, $U''(\cdot)<0$, and $V'(\cdot)>0$. The agent's compensation is restricted[5] to the real interval $[\underline{\phi},\overline{\phi}]$.

The principal and agent share identical state beliefs on (y,z) encoded in the density function $f(y,z;a)$. The likelihood ratio $f_a(y,z;a)/f(y,z;a)$ is assumed to be continuously differentiable in y and z, with a support independent of the agent's action. The distribution of y (and z), $F(y|a)$ (and $F(z|a)$) satisfies a first-order stochastic dominance condition as in Holmström (1979). The structure of the choice problem, the utility functions of the principal and the agent, and the set of available options are common knowledge.

The principal's problem is characterized by the following optimization program:

$$\max_{\phi,a} \quad \iint W[n(y,z)-\phi(y,z)]f(y,z;a)\,dydz \tag{1}$$

subject to:

$$\iint U[\phi(y,z)]f(y,z;a)\,dydz - V(a) \geq \underline{U}, \tag{1a}$$

$$a \epsilon \operatorname*{argmax}_{\hat{a}} \quad \iint U[\phi(y,z)]f(y,z;\hat{a})\,dydz - V(\hat{a}), \text{ and} \tag{1b}$$

$$a \epsilon [\underline{a},\overline{a}],\ \phi \epsilon [\underline{\phi},\overline{\phi}]. \tag{1c}$$

In order to obtain an explicit characterization of the optimal contract, we use the first-order approach and assume that the agent chooses an action at which his or her expected utility is at a stationary point.[6] That is, constraint (1b) is replaced by the following first-order condition assuming the usual regularity conditions:

$$\iint U[\phi(y,z)]f_a(y,z;a)\,dydz - V'(a) = 0. \tag{1b$'$}$$

We assume the program (1) has an interior (second-best) solution where the Euler-Lagrange first-order necessary conditions hold.[7] As in Holmström (1979), pointwise optimization[8] yields the following Euler-Lagrange first-order conditions at the optimal second-best contract $[\phi^*(y,z),a^*]$:

$$\frac{W'[n-\phi^*(y,z)]}{U'[\phi^*(y,z)]} = \lambda + \mu\frac{f_a(y,z;a^*)}{f(y,z;a^*)} \quad \text{for all } y \text{ and } z \tag{2}$$

where $\lambda>0$ and $\mu>0$ are Lagrange multipliers of the constraints (1a) and (1b′), respectively. The entire problem of what information is economically sufficient to construct $\phi^*(y,z)$ reduces to determining the amount of aggregation in the likelihood ratio $f_a(y,z;a^*)/f(y,z;a^*)$ as can be seen by inspection of equation (2).

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[5] Without this restriction the existence of an optimal solution cannot be guaranteed (see Mirrlees 1974).

[6] See Mirrlees (1979) and Banker and Datar (1986) for sufficient conditions to insure the validity of the first-order approach.

[7] This assumption simplifies the mathematics without affecting any of the economic insights.

[8] See Clarke and Darrough (1980) for an exhaustive treatment of these technicalities.

Definition 1: A statistic $T(y,z)$ is *statistically sufficient* for a class of density functions $f(y,z;a)$ indexed by a parameter a if, and only if, the factorization:

$$f(y,z;a)=g(y,z)\cdot h(T(y,z);a) \tag{3}$$

holds for (almost) every y,z, and all a, where $g(\cdot)$ is a function only of (y,z) independent of the parameter a and $h(\cdot)$ is a function that depends on (y,z) only through the transformation $t=T(y,z)$ (e.g., see DeGroot 1970).

The definition states that if t is statistically sufficient for y and z with respect to a, there is no loss of information in using t instead of y and z to make inferences about a, for all values of a. Note that the definition allows for the possibility that the only sufficient statistic for the signals y and z may be the trivial sufficient statistic $id(y,z)=(y,z)$.

Definition 2: For an agency in which the second-best action $a=a^*$ is to be implemented, an aggregate signal $m=M(y,z;a^*)$ is *locally economically sufficient* for the basic accounting signals y and z, if the optimal incentive contract $\phi^*(y,z)$ can be written as $\psi(m)$ for (almost) every y,z.

It is important to note that the notion of local economic sufficiency of the aggregate m for the signals y and z is defined in relation to a particular agency; that is, it depends on the economic characteristics of the agency such as the utility functions of the principal and agent. The utility functions influence the optimal incentive contract and the agent's effort choice. In contrast, global economic sufficiency requires that for all agencies, regardless of the local economic characteristics, the optimal compensation scheme can be based on the particular aggregate $\alpha=\alpha(y,z)$.

Definition 3: An aggregate $\alpha=\alpha(y,z)$ is *globally economically sufficient* for the basic accounting signals y and z if, for implementing any action a, the optimal incentive contract $\phi(y,z)$ can be written as $\psi(\alpha)$ for (almost) every y, z.

As it relates to aggregation, Holmström's (1979) result implies that the optimal sharing rule based on the individual signals y and z will strictly Pareto dominate a sharing rule based on the aggregate $\alpha=\alpha(y,z)$ alone, if, and only if, it is false that $f(y,z;a)=g(y,z)\cdot h(\alpha;a)$ for all a. But this means that the same aggregate $\alpha=\alpha(y,z)$ is optimal for any action which implies that whenever Holmström's (1979) result holds, the locally economically sufficient aggregate measure is always globally economically sufficient.

The "only if" (necessity) part of the result is easy to see because if α is a sufficient statistic, then

$$\frac{f_a(y,z;a)}{f(y,z;a)}=\frac{h_a(\alpha;a)}{h(\alpha;a)}$$

for all a, and it follows by inspection of condition (2) that the optimal second-best contract is independent of y and z.

Holmström assumes the "all a or no a" condition to prove the sufficiency part of the result that a contract based on y and z will strictly Pareto dominate a contract based on α alone if α is not a sufficient statistic for y and z.[9] For a given $\alpha = \alpha(y,z)$, this condition means that $f_a(\cdot)/f(\cdot)$ can be written as equal to simply $B(\alpha, a)$ either for all a or for no a. For the class of distributions considered in the next section, we show that the sufficiency part of the result is true *only* when the "all a or no a" condition holds.

Holmström explicitly excludes from his analysis the class of distributions for which there may be some aggregates α such that $f_a(\cdot)/f(\cdot) = B(\alpha, a)$ for some a but not all a. Recognizing this restriction Baiman (1982, 188) cautions that "Holmström's result should be carefully applied since technically it holds only for those.... [information systems] for which the [above] condition holds for either all a or no a." Baiman (1982, 188) further notes that "Those [joint signal] distributions for which the . . . [likelihood ratio is a function of α] for some but not all . . . [effort] levels are excluded from Holmström's (1979) analysis. The size of the class of distributions thus excluded has not yet been established." In the subsequent sections, we show that the class excluded from Holmström's analysis for the aggregation problem considered in this paper is large relative to the class which satisfies Holmström's conditions. Furthermore, unlike the "all a or no a" class, the optimal second-best compensation scheme does not use all the information in the sufficient statistic. In fact, using all such information leaves the principal and agent strictly worse off.

II. Characterization of Global Economic Sufficiency

The design of accounting aggregates is greatly facilitated if the same aggregate $\alpha = \alpha(y,z)$ is locally economically sufficient for all agencies and optimal actions a^* of the agent. This motivates our search for globally economically sufficient aggregates. We characterize the conditions under which such aggregates will obtain for a broad class of distributions for which the density function $f(\cdot)$ of stochastic signals y and z is given by the general form:

$$f(y,z;a) = \exp\{p(a)y + q(a)z - r(a) + s(y) + t(z - \gamma y)\} \tag{4}$$

where a is the agent's effort choice, $p(\cdot)$, $q(\cdot)$, $r(\cdot)$, $s(\cdot)$, and $t(\cdot)$ are arbitrary functions of a, y or z as indicated, and γ is a scalar parameter.[10] This class of joint probability density functions admits as conditional distributions of the signal $y|z$

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[9] Holmström (1979) assumes this "all a or no a" condition to enable him to integrate $f_a(\cdot)/f(\cdot) = h(\cdot)$ to obtain an expression that characterizes α as a sufficient statistic.

[10] Since $p(\cdot)$, $q(\cdot)$, $r(\cdot)$, $s(\cdot)$, and $t(\cdot)$ are arbitrary functions, *any number* of parameters can be considered. The class does not impose severe restrictions: the distribution need not be symmetric nor bell shaped, it may be convex or concave and skewed on either side of the mean. The class includes truncated distributions and, hence, the requirement (as in the bivariate normal distribution) that arbitrary large or small values of the signal must have nonzero probability densities need not be imposed. Furthermore, the use of this class permits the means, variances, and covariances to be functions of the agent's action parameter a. These results have also been extended to other classes of distributions (see Amershi 1989 and Amershi and Hughes 1989).

(and also $z|y$) many well-known common distributions such as (truncated) normal, exponential, gamma, and inverse Gaussian. Further, these conditional distributions include many of the common parametric functional forms for continuous probability distributions that have been considered in the agency literature[11] in accounting and elsewhere.

Observe that differentiating the expression in equation (4) with respect to a produces the likelihood ratio $f_a(\bullet)/f(\bullet)=p_a(a)y+q_a(a)z-r_a(a)$. Further,

$$\frac{\partial}{\partial y}\frac{f_a(\bullet)}{f(\bullet)} \text{ and } \frac{\partial}{\partial z}\frac{f_a(\bullet)}{f(\bullet)}$$

equal $p_a(a)$ and $q_a(a)$, respectively. We denote the likelihood ratio at the second-best effort a^* by:

$$\tau(y,z;a^*)=p_a(a^*)y+q_a(a^*)z-r_a(a^*).$$

Lemma 1: If the density function $f(y,z;a)$ belongs to the class in equation (4), then an aggregate $m=M(y,z;a^*)$ is locally economically sufficient for the accounting signals y and z for any agency (with a risk-neutral principal) defined by equations (1), (1a), (1b′), and (1c), if, and only if, there exists a function η such that $\eta(m)=\tau(y,z;a^*)$ for all (y,z). In particular, $\tau(y,z;a^*)$, an aggregation of y and z is always locally economically sufficient.

Proof: See Appendix.

Lemma 1 states that for a risk neutral principal, the information that is economically sufficient is that found in the likelihood ratio $f_a(\bullet)|f(\bullet)$ at a^*. Thus, in order that an aggregation $M(y,z;a^*)$ be locally economically sufficient it is necessary and sufficient that the information partition of M as a function of all signals $S=\{(y,z)\}$ be at least as fine as that of the likelihood ratio $\tau(y,z;a^*)$ $=p_a(a^*)y+q_a(a^*)z-r_a(a^*)$. The resulting loss in information from (y,z) will not result in any economic loss to the agency. Of course, for different agencies, the agent's optimal action choice a^* and thus $\tau(y,z;a^*)$ will, in general, be different. The result can be extended to agencies with risk-averse principals, except that the output $n=n(y,z)$ is also required for optimal risk-sharing. Though n is an aggregate performance measure, no further economic insights result from this extension, so it is not pursued here.

Our objective is to examine when the locally economically sufficient aggregates described in Lemma 1 will also be globally economically sufficient. The economically sufficient aggregate $\tau(y,z;a^*)$ derived at a^* will be globally economically sufficient if this *same* aggregate is locally economically sufficient for all a. This will occur if the likelihood ratio at any a is derivable from the likelihood ratio of a particular a^*. That is,

$$\tau(y,z;a)=p_a(a)y+q_a(a)z-r_a(a)=\eta^a(\tau(y,z;a^*)), \text{ for all } y,z,a,$$

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[11] See, for example, Mirrlees (1976), Holmström (1979, 1982), Baiman and Demski (1980b), and Basu et al. (1985).

where η^* is a function from $R \rightarrow R$. Note that the contract $\phi^*(\cdot)$ that induces the action a is based on $\tau(y,z;a)$. Since $\tau(y,z;a)$ is linear in y and z for all a, it is evident that the above condition can hold if, and only if, $p_a(a)/q_a(a)=p_a(a^*)/q_a(a^*)$ for all a. We then relate these results to Holmström's (1979) "all a or no a" condition.[12] This is formalized in the following:

Proposition 1: If the joint density function $f(y,z;a)$ is of the form in equation (4) with $p_a(a)>0$, $q_a(a)>0$, then the following statements are equivalent: (i) Holmström's (1979) "all a or no a" condition holds, (ii) the locally economically sufficient aggregate $\tau(y,z;a^*)=p_a(a^*)y+q_a(a^*)z-r_a(a^*)$ for any particular a^* is globally economically sufficient for y and z with respect to all a, and (iii) $p(a)$ and $q(a)$ are linearly dependent, that is, $p(a)=Kq(a)+L$ for all a, where K and L are constants.

Proof: See Appendix.

Statements (i) and (ii) of Proposition 1 indicate that utility independent aggregation is driven by the "all a or no a" condition. An implication of Holmström (1979) is that if the "all a or no a" condition holds the locally economically sufficient aggregate is also globally economically sufficient and a sufficient statistic for the signals (y,z) with respect to a. It immediately follows that if the locally economically sufficient aggregate is not a sufficient statistic, then there exist actions for which the aggregate is not optimal and for which there is value to knowing the individual signals y and z.

Our proposition goes further in showing that for the class that we consider, the "all a or no a" condition is also necessary for global economic sufficiency of an aggregate. That is, outside the "all a or no a" class, global economic sufficiency cannot obtain and the locally economically sufficient aggregate will depend on the production function, specific utility functions of the principal and agent and the optimal action a^* that is induced.

Statements (i) and (iii) of Proposition 1 precisely characterize the "all a or no a" condition as the subset of density functions of the form in equation (4) for which $p(a)$ and $q(a)$ are linearly dependent. Thus, a relatively strong condition needs to be imposed for density functions in equation (4) to belong to the "all a or no a" subclass. In the function space of all possible curves relating $p(a)$ and $q(a)$, the "all a or no a" subclass corresponds to the case in which $p(a)$ is a *linear* function of $q(a)$. In order to gain further intuition, consider the action a as parameterizing the plot of the points $(p(a), q(a))$ in a two-dimensional graph. Linear dependency of $p(a)$ and $q(a)$ requires that of all possible curves $p(a)$ that could be drawn for actions $a \epsilon [\underline{a}, \bar{a}]$, the plot of $p(a)$ versus $q(a)$ is a straight line. If one assumes that all possible curves (including the straight line) are equally likely, then the Lebesgue measure of the size of the subclass of densities in equation (4) for which

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[12] We note that Holmström's (1982) result on "globally insufficient" statistics is not a generalization of his (1979) "all a or no a" result. Holmström defines an aggregate to be "globally insufficient" if it contains less information than the likelihood function *at all a*. Since an economically sufficient aggregate must have at least the information content of the likelihood function at the optimal a, it follows by definition of globally insufficient aggregations that these aggregates can never be economically sufficient.

$p(a)$ and $q(a)$ are linear has measure zero.[13] In other words, the "all a or no a" condition is nongeneric in the class of densities in equation (4).

It is, of course, possible that every joint density $f(y,z;a)$ in the function space is not equally likely. There may be reason to place a larger probability mass on the "all a or no a" subclass relative to its complement. If this were the case, then the "all a or no a" class would not be negligible in a meaningful economic sense. To investigate this possibility and to gain further insight, we expand our characterization of the "all a or no a" condition and interpret it in terms of the statistical concepts of sensitivity, precision, and intensity (see Banker and Datar 1989).

III. Sensitivity, Precision, and Economic Sufficiency

The precision of a distribution is a well-established notion in statistics and is defined as the inverse of the variance (see, e.g., DeGroot 1975, 341). Denote the *precisions* of signals y and z at any action a by:

$$\rho_1^2(a)=\frac{1}{\mathrm{Var}(y|a)} \text{ and } \rho_2^2(a)=\frac{1}{\mathrm{Var}(z|a)},$$

respectively. The *sensitivity* of a signal at any a is defined as the change in the expected value of the signal in response to a change in the level of the agent's effort. When the signals y and z are uncorrelated, the sensitivity of signal y is denoted by $\mu_{1a}(a)$ where:

$$\mu_{1a}(a)=\frac{\partial}{\partial a}E(y|a).$$

Similarly, the sensitivity of signal z is denoted by $\mu_{2a}(a)$ where:

$$\mu_{2a}(a)=\frac{\partial}{\partial a}E(z|a).$$

Finally, the *intensity* θ_i of a signal is defined to be equal to its sensitivity times precision, that is $\theta_i(a)=\rho_i^2(a)\mu_{ia}(a)$ for $i=1,2$ (the subscripts $i=1,2$ are for the signals y and z, respectively).

When the signals are uncorrelated, Banker and Datar (1989, prop. 3) show that $p_a(a^*)=\rho_1^2\mu_{1a}=\theta_1(a^*)$ and $q_a(a^*)=\rho_2^2\mu_{2a}=\theta_2(a^*)$ where ρ_i, μ_{ia} and θ_i, $i=1,2$, are evaluated at $a=a^*$.[14] In Proposition 1, we showed that for the class in equation (4), the "all a or no a" condition is equivalent to $p_a(a)|q_a(a)=\text{constant}$ (K) for all a. Thus, the "all a or no a" condition is equivalent to the requirement that the ratio of the intensities of the two signals y and z with respect to the agent's effort a is the *same* constant for *all* possible effort levels.

Consider the example of aggregating labor costs (y) and material costs (z) within a cost center which produces a specified level of output. The signals y and

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[13] Such measure-theoretic characterizations of the "size" of economic environments are commonly used in the economics literature. For example, Kreps and Wilson (1982) use similar arguments to show that perfect equilibria are generically the same as sequential equilibria.

[14] The weights on the individual signals in the optimal aggregate are the coefficients in a linear regression of the signals y and z on the agent's action a.

z are, of course, random variables that depend on the managerial effort provided as well as on random shocks affecting production. We write these costs as negative numbers so that higher levels of managerial effort $a \epsilon A$ make higher realizations of y and z more likely.

Typically, the ratio of the sensitivity of a signal (say labor cost) to its variance will vary with the agent's effort level. The "all a or no a" condition requires that this ratio vary in exactly the same way for the material cost signal as well. Alternatively put, the "all a or no a" condition requires that the ratio of the impact of increases in the manager's effort on decreases in expected material costs to the impact of such increased effort on decreases in expected labor costs be proportional to the ratio of the variances of the material and labor cost signals for all effort levels $a \epsilon A$.

The above characterization suggests that the "all a or no a" condition is not very plausible even when the material and labor cost signals are uncorrelated. Our intuition would suggest that if the two signals are correlated (which is the likely case), even more restrictive conditions would have to be satisfied for density functions to belong to the "all a or no a" subclass. This intuition is formalized in Proposition 2.

Proposition 2: For the family of density functions defined in equation (4), the "all a or no a" subclass is equivalent to

$$\frac{\mu_{2a}(a)}{\mu_{1a}(a)} = \frac{K\gamma}{K+\gamma} + \frac{1}{K+\gamma}\,\frac{\rho_1^2(a)}{\rho_2^2(a)}$$

for all a, where $\gamma = \mathrm{Cov}(y,z)/\mathrm{Var}(y)$, K is an arbitrary constant, and μ_{1a}, μ_{2a}, ρ_1^2, and ρ_2^2 are, in general, functions of a.

Proof: See Appendix.

It follows from Proposition 2 that if, in our example, labor and material costs are correlated, one way for $p(a)$ and $q(a)$ to be linearly dependent is that:

$$\frac{\mu_{2a}(a)}{\mu_{1a}(a)} \text{ and } \frac{\rho_1^2(a)}{\rho_2^2(a)}$$

are both constants for all a. This implies that if the "amount" of uncertainty in the material cost and labor cost signals as measured by their variances are proportional for all a and if increases in the manager's effort causes expected material costs and expected labor costs to decrease proportionately for all a, the density functions will belong to the "all a or no a" subclass.

Finally, consider the general case where $\gamma \neq 0$ and in which either

$$\frac{\mu_{2a}(a)}{\mu_{1a}(a)} \text{ or } \frac{\rho_1^2(a)}{\rho_2^2(a)}$$

or both are not constants. In this case, $p(a)$ and $q(a)$ will be linearly dependent if, and only if,

$$\frac{\mu_{2a}(a)}{\mu_{1a}(a)}$$

is a specific linear function of

$$\frac{\rho_1^2(a)}{\rho_2^2(a)}$$

over the domain defined for $a \epsilon A$. It is important to note, however, that this condition is very restrictive since the slope and the intercept coefficients of the linear function for various $a \epsilon A$ must be related in a very specific way because there is only one degree of freedom in choosing the coefficients.

Our expanded characterization of the "all a or no a" subclass in Proposition 2 suggests that strong conditions on the statistical relations and properties of the signals y and z must hold for the joint density function to belong to the "all a or no a" class. Consequently, utility independent aggregation will, in general, not be optimal. The complement of the "all a or no a" subclass in the class in equation (4) is a much larger class. It is important, therefore, to consider properties of optimal aggregates for performance evaluation purposes outside the "all a or no a" subclass.

IV. Optimal Aggregation Outside the "all *a* or no *a*" Subclass

Linearly independent $p(a)$ and $q(a)$ do not qualify for the "all a or no a" subclass. In this case, Lehmann (1983) shows that the *one and only* sufficient statistic for (y,z) with respect to a in the class in equation (4) is the trivial statistic $id(y,z)=(y,z)$, a *two-dimensional* mapping of (y,z).

It follows from Lemma 1 that a locally economically sufficient aggregate always exists and is the *single-dimensional* aggregate $\tau(y,z;a^*)=p_a(a^*)y+q_a(a^*)z-r_a(a^*)$. Outside the "all a or no a" subclass, this aggregate is clearly not a sufficient statistic for the signals (y,z) with respect to a. Yet, in contrast to Holmström's (1979) result, there is no value to knowing y and z given the aggregate $\tau(y,z;a^*)$ even though $\tau(y,z;a^*)$ is not a sufficient statistic for (y,z). Aggregation for performance evaluation is likely to be far more pervasive than implied by statistical sufficiency.

To see how the concepts of sensitivity and precision enable characterization of the properties of optimal aggregates outside the "all a or no a" subclass, consider the general case of correlated signals. The sensitivity $\mu_{1a}(a)$ of signal y is replaced by the (adjusted) sensitivity $\xi_{1a}(a)=\mu_{1a}(a)-k(a)\rho_2^2(a)\mu_2(a)$ and the sensitivity $\mu_{2a}(a)$ of signal z is replaced by the (adjusted) sensitivity $\xi_{2a}(a)=\mu_{2a}(a)-k(a)\rho_1^2(a)\mu_{1a}(a)$ where $k(a)\equiv\text{cov}(y,z;a)$ (see Banker and Datar 1989). It follows from Lemma 1 and the fact that $p_a(a^*)=\rho_1^2(a^*)\xi_{1a}(a^*)=\theta_1(a^*)$ and $q_a(a^*)=\rho_2^2(a^*)\xi_{2a}(a^*)=\theta_2(a^*)$ where $\theta_1(a^*)$ and $\theta_2(a^*)$ are the intensities of the individual signals at a^*, that we can characterize the optimal non-sufficient aggregate in terms of the statistical concepts of sensitivity, precision, and intensity. The crucial point to note is that the locally economically sufficient aggregate for different agencies will put different weights on the individual signals depending on the sensitivity and precision of the signals at the particular effort level that is induced.

Thus, our results are analogous to Holmström (1979) in that purely statistical concepts can be applied to compare non-sufficient aggregates outside the "all a or no a" class. A compensation contract based on a non-sufficient aggregate will result in no economic loss, if the relative weights on the individual signals are proportional to the product of the sensitivity times precision (or intensity) of the two signals. If any other aggregate is employed, there will be value to basing the contract on the individual signals as well.

This raises the question of whether financial accounting aggregations will be optimal for performance evaluation. For instance, if the agent's effort affects both revenues and costs, is it optimal to use profits equal to revenues minus costs to motivate and evaluate the manager? In the context of the agency model presented here, the answer is no, in general. The optimal aggregate will put greater weight on the signal that more sharply reflects the effects of the manager's action, that is, the signal which is more sensitive to the manager's effort and has greater precision. Optimal aggregation for performance evaluation appears to be more consistent with measures such as management-by-objectives that place differential weights on various measures of performance rather than financial accounting aggregations that put equal weights on the signals. Weighting signals equally will only be optimal if the two signals are very similarly influenced by the manager's effort and have similar precision levels, that is, if they have equal intensity.

One should not, however, interpret managerial compensation contracts that on the surface are based on financial accounting aggregates such as profits, as being necessarily non-optimal. These contracts may not be inefficient since profits are often only a starting point in evaluating a manager and are frequently adjusted for unusual circumstances to more closely reflect a manager's performance. Furthermore, it is important to note that our conclusion on the non-optimality of financial accounting aggregates is conditioned by the agency model we used. What happens in richer and more complex settings than the one modeled is an open question.

In the case of density functions outside the "all a or no a" subclass, the sufficient statistic (y,z) has much more information than the economically sufficient likelihood ratio $\tau(y,z;a^*)$ for any a^*.[15] A question is the impact on the agency of using information from a sufficient statistic over and above that which is the locally economically sufficient aggregate. It follows directly from the Euler-Lagrange equation in condition (2) that if any compensation scheme $\tilde{\phi}$ uses information from $\tau(y,z;a^*)$ and additional information from the sufficient statistic (y,z) with positive probability, the principal is strictly worse off. Within the "all a or no a" subclass, the likelihood ratio is itself a sufficient statistic so the question of using more information in the compensation contract than that found in the likelihood ratio does not arise.

V. An Example

We illustrate the ideas about economic and statistical sufficiency and optimal aggregation by considering the case of a salesperson who generates revenues from the sales of two products. We denote the revenues generated from Product 1 by y and the revenues from Product 2 by z. Signals y and z provide information about the manager's effort a.[16] Higher levels of the salesperson's effort $a \epsilon A$ make higher realizations of y and z more likely. The signals y and z are correlated random variables that reflect the effect of managerial effort as well as the random shocks affecting sales revenues and are assumed to follow a bivariate normal distribution. Thus:

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[15] Given the specific utility function of the agent and the induced effort level, the sufficient statistic partition (if available) can be used to construct any performance evaluation measure. However, note unlike the "all a or no a" subclass, the construction of the optimal aggregate depends crucially on the specific parameters of the agency.

$$f(y,z;a)=\frac{\rho_1\rho_2}{2\pi\sqrt{1-\omega^2}}\exp\left\{-\frac{1}{2(1-\omega^2)}[(y-\mu_1(a))^2\rho_1^2\right.$$

$$\left.-2\omega\rho_1\rho_2(y-\mu_1(a))(z-\mu_2(a))+(z-\mu_2(a))^2\rho_2^2]\right\} \tag{5}$$

where:

$\mu_1(a)=\log(a)$ is the expected value of signal y given the salesperson's action a,
$\mu_2(a)=3a^3$ is the expected value of signal z given the salesperson's action a,
ρ_1^2=the precision of y and is equal to the inverse of the variance σ_1^2,
ρ_2^2=the precision of z and is equal to the inverse of the variance σ_2^2, and
$\omega=\gamma\sigma_1/\sigma_2$ denotes the correlation between y and z.

It is easy to verify that the bivariate normal distribution belongs to the class in equation (4).[17] In the case of the bivariate normal, the precisions of the signals y and z and the correlation between y and z are independent of a. For the generic class described in equation (4), the precisions and correlation could also be functions of a.

Differentiating $\mu_1(a)$ and $\mu_2(a)$ we have:

$$\mu_{1a}(a)=\frac{1}{a} \text{ and } \mu_{2a}(a)=9a^2.$$

As described in Proposition 2, density functions parameterized by a belong to the "all a or no a" subclass if, and only if:

$$\frac{\mu_{2a}}{\mu_{1a}}=\frac{K\gamma}{K+\gamma}+\frac{1}{K+\gamma}\,\frac{\rho_1^2}{\rho_2^2} \text{ for all } a. \tag{6}$$

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[16] For ease of exposition and in order to conform to the traditional agency literature, we assume the agent's action to be single-dimensional. Our analysis and results extend directly to multi-dimensional actions (a_1, a_2) where generally each dimension can affect either or both of labor and material costs (see Amershi 1989 for further details).

[17] For the bivariate normal distribution to belong to equation (4), the parameters γ, ρ_1^2, and ρ_2^2 must be independent of a. For other distributions, including the truncated bivariate normal, however, this restriction is not required. In addition, considering the bivariate normal distribution implies that negative realizations of the signals y and z are possible. For reasonable values of μ_i and ρ_i, this probability is very small. We could use a truncated normal distribution which also belongs to the class in equation (4) and restrict the values of y and z to be positive. This makes the computations considerably more complex and the example less clear without any additional insights being gained.

The right-hand side of equation (6) is a constant, while the left-hand side $\mu_{2a}/\mu_{1a} = 9a^3$ varies with a. The condition of Proposition 2, therefore, is not satisfied and the density function in our example does not belong to the "all a or no a" subclass.

Another question here is whether there exist functions $\mu_1(a)$ and $\mu_2(a)$ in the bivariate normal density class described in equation (5) such that the density falls within the "all a or no a" subclass. It follows from the preceding analysis that if, and only if, the signals y and z are such that $\mu_{1a}(a)=\beta_1\mu(a)$ and $\mu_{2a}(a)=\beta_2\mu(a)$ where $\mu(a)$ is any general function then $\mu_{2a}(a)/\mu_{1a}(a)$ would equal a constant independent of a, and the conditions of Proposition 2 would be satisfied. In the case of the bivariate normal distribution, therefore, the "all a or no a" condition only holds in the special situation in which the sensitivities of the two signals y and z are exactly proportional.

Assuming a risk-neutral principal and an interior solution, the optimal contract is characterized by the Euler-Lagrange conditions in equation (2):

$$\phi^*(y,z)=U'^{-1}\left(\frac{1}{\lambda+\mu f_a(\cdot)/f(\cdot)}\right)$$

where the Lagrange multipliers λ and μ are strictly positive. For the bivariate normal density function in equation (5),

$$\begin{aligned}\tau(y,z;a^*)&=\frac{f_a(y,z;a^*)}{f(y,z;a^*)}=-\frac{1}{2(1-\omega^2)}[-2\rho_1^2(y-\mu_1(a^*))\mu_{1a}(a^*)\\&\quad+2\omega\rho_1\rho_2\mu_{1a}(a^*)(z-\mu_2(a^*))+2\omega\rho_1\rho_2\mu_{2a}(a^*)(y-\mu_1(a^*))\\&\quad-2\rho_2^2(z-\mu_2(a^*))\mu_{2a}(a^*)]\\&=\left[\frac{\rho_1^2}{(1-\omega^2)}\frac{1}{a^*}-\frac{\omega\rho_1\rho_2}{(1-\omega^2)}9a^{*2}\right]y+\left[\frac{\rho_2^2 9a^{*2}}{(1-\omega^2)}-\frac{\omega\rho_1\rho_2}{(1-\omega^2)}\frac{1}{a^*}\right]z\\&\quad+\Bigg[\frac{\omega\rho_1\rho_2}{(1-\omega^2)}3a^{*2}-\frac{\rho_1^2}{(1-\omega^2)}\frac{\log a^*}{a^*}\\&\quad+\frac{\omega\rho_1\rho_2}{(1-\omega^2)}9a^{*2}\log a^*-\frac{\rho_2^2 27a^{*5}}{(1-\omega^2)}\Bigg]\end{aligned}\tag{7}$$

which is the optimal aggregate of y and z. The coefficients on y and z are clearly functions of a^* and, therefore, the optimal aggregate will vary with the optimal action that is induced for different agents.

It follows from equation (7) that the optimal compensation scheme depends on (y,z) only through the single-dimensional locally economically sufficient linear aggregation of the revenue data $\tau(y,z;a^*)$, and not the individual values of y and z from which $\tau(y,z;a^*)$ is derived. For the density functions defined in equation (5), however, it follows from Lehmann (1983, 44) that the (minimal) sufficient statistic is given by:

$$\hat{T}(y,z)=(y,z)$$

which is two-dimensional. In other words, there is no one-dimensional aggregation of (y,z) which is statistically sufficient. Thus, the one-dimensional locally economically sufficient aggregate used to compute the agent's compensation is not a sufficient statistic. Yet, there is no value to knowing the additional information contained in the sufficient statistic (y,z).

VI. Concluding Remarks

The basic conclusion of the analysis above is that aggregation for performance evaluation will not, in general, be utility independent. It is only within the "all a or no a" class considered by Holmström that the optimal aggregate is a sufficient statistic for the individual signals with respect to the agent's action so that the same aggregate can be used to evaluate managerial performance independent of the specific utility function and the optimal action choice of the agent. For a broad class of distributions, we characterize the "all a or no a" subclass as that class of joint density functions for which the ratio of the intensities (sensitivity times precision) of the two signals y and z is the same for all a. The characterization suggests that the "all a or no a" class is likely to be much smaller than its complement.

Outside the "all a or no a" subclass, it is indeed possible to aggregate accounting signals for evaluating the agent's performance without any economic loss to the principal. The optimal aggregate, however, is not independent of the agent's utility function and the induced effort choice. It is also not a sufficient statistic for the individual signals with respect to the agent's effort. The key insight in this latter case is that the information lost in a statistical sense results in no economic loss to the principal because the lost information is of no value for contracting (risk sharing or incentive) purposes. In fact, using all the variability in the sufficient statistic in a compensation contract will make the principal strictly worse off because it imposes more risk on the agent than is optimal. Our analysis provides insights into a different statistical approach for comparing non-sufficient aggregates outside the "all a or no a" class where the sufficiency/non-sufficiency dichotomy cannot be applied.

An implication of our analysis is that rational behavior may result in optimal contracts, in general, being written on aggregates that are not sufficient statistics for the basic signals. This is contrary to the conclusion drawn from Holmström's results that when contracts based on aggregates are observed, the aggregates must be sufficient statistics for the individual signals.

Appendix

Proof of Lemma 1

Differentiating $f(y,z;a)$ with respect to a we immediately obtain:

$$\frac{f_a(y,z;a^*)}{f(y,z;a^*)}=p_a(a^*)y+q_a(a^*)z-r_a(a^*)=\tau(y,z;a^*).$$

From the first order condition in equation (2), for $\phi^*\epsilon(\underline{\phi},\overline{\phi})$ and a risk-neutral principal yields:

$$\frac{1}{U'(\phi)}=\lambda+\mu\frac{f_a(y,z;a^*)}{f(y,z;a^*)}.$$

Therefore, $\phi^*=U'^{-1}[1/(\lambda+\mu f_a/f)]$

$$=U'^{-1}[1/(\lambda+\mu\tau(y,z;a^*))]$$

and the result follows immediately for ϕ^* in the interior. Furthermore, to determine when ϕ^* will be at its lower bound $\underline{\phi}$, we simply need to evaluate when:

$$\frac{1}{U'(\phi)}\geq\lambda+\mu\frac{f_a(y,z;a^*)}{f(y,z;a^*)}.$$

Since $f_a/f=\tau(y,z;a^*)$ at $a=a^*$, it is evident that we do not need additional information about y and z beyond that provided by m to determine when ϕ^* will be at its lower bound value. A similar argument also establishes the sufficiency of m for determining when ϕ will be at its upper bound.

Proof of Proposition 1

To show equation (1)⇒equation (2): Under the "all a or no a" condition, Holmström (1979) shows that a locally economically sufficient statistic is a sufficient statistic and globally economically sufficient.

To show equation (2)⇒equation (3): Suppose first that for some a^*, the locally economically sufficient aggregate $\tau(y,z;a^*)$ is also globally economically sufficient. That is:

$$\tau(y,z;a^*)=p_a(a^*)y+q_a(a^*)z-r_a(a^*)$$

is also locally economically sufficient for all $a\epsilon A$. By Lemma 1, this is possible only if for each $a\epsilon A$ there exists a function η^a: $R\rightarrow R$ such that:

$$\begin{aligned}\eta^a(\tau(y,z;a^*))&=p_a(a)y+q_a(a)z-r_a(a)\\&=\tau(y,z;a)\end{aligned}\tag{A1}$$

But $\eta^a(\tau(y,z;a^*))=\eta^a(p_a(a^*)y+q_a(a^*)z-r_a(a^*))$ for all y and z.

Therefore, partially differentiating equation (A1) with respect to y yields:

$$H_a\cdot p_a(a^*)=p_a(a)>0\tag{A2}$$

where:

$$H_a=\frac{\partial}{\partial t}\eta^a(t)$$

evaluated at $t=\tau(y,z;a^*)$. Similarly, by partially differentiating equation (A1) with respect to z we obtain:

$$H_a\cdot q_a(a^*)=q_a(a)>0.\tag{A3}$$

Therefore, from equations (A2) and (A3) we have for all $a\epsilon A$:

$$\frac{p_a(a)}{q_a(a)}=\frac{p_a(a^*)}{q_a(a^*)}=\text{a positive constant.}\tag{A4}$$

Therefore, there exists constants d_1, and d_2, both not zero, such that:

$$d_1 p_a(a) + d_2 q_a(a) = 0 \text{ for all } a \in A.$$

Integrating with respect to a we obtain:

$$d_1 p(a) + d_2 q(a) = d_3$$

where d_3 is a constant. That is, $p(a)$ and $q(a)$ are linearly dependent.

To show equation (3) $\Rightarrow$ equation (1): If $p(a)$ and $q(a)$ are linearly dependent the locally economically sufficient aggregate $\tau(y,z;a^*) = f_a(y,z;a^*)/f(y,z;a^*)$ is also globally economically sufficient (sufficient statistic). That is, Holmström's (1979) first order condition holds not only at a^* but for all a. The likelihood ratio can then be written as a function of the same aggregate for all a, which is precisely the "all a or no a" condition.

Proof of Proposition 2

By Proposition 1, the "all a or no a" condition is equivalent to economic sufficiency if, and only if, $p(a)$ and $q(a)$ are linearly dependent. By definition, $p(a)$ and $q(a)$ are linearly dependent if, and only if, $p_a(a)/q_a(a) = K$ where K is an arbitrary constant.

Following Banker and Datar (1989, prop. 4) for correlated signals, we have:

$$p_a(a) = (\mu_{1a} - k\rho_2^2\mu_{2a})\rho_1^2 \text{ and } q_a(a) = (\mu_{2a} - k\rho_1^2\mu_{1a})\rho_2^2$$

where $k = \text{cov}(y,z;a)$. That is:

$$p_a(a) = \rho_1^2\mu_{1a} - \gamma\rho_2^2\mu_{2a}$$

and,

$$q_a(a) = \rho_2^2\mu_{2a} - \gamma\rho_2^2\mu_{1a}.$$

Therefore, we have:

$$\rho_1^2\mu_{1a} - \gamma\rho_2^2\mu_{2a} = K(\rho_2^2\mu_{2a} - \gamma\rho_2^2\mu_{1a})$$

that is,

$$(\rho_1^2 + K\gamma\rho_2^2)\mu_{1a} = (K+\gamma)\rho_2^2\mu_{2a}.$$

Hence,

$$\frac{\mu_{2a}}{\mu_{1a}} = \frac{K\gamma}{K+\gamma} + \frac{1}{K+\gamma}\,\frac{\rho_1^2}{\rho_2^2}.$$

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Positive Accounting Theory: A Ten Year Perspective

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ABSTRACT: This paper reviews and critiques the positive accounting literature following publication of Watts and Zimmerman (1978, 1979). The 1978 paper helped generate the positive accounting literature which offers an explanation of accounting practice, suggests the importance of contracting costs, and has led to the discovery of some previously unknown empirical regularities. The 1979 paper produced a methodological debate that has not been very productive. This paper attempts to remove some common misconceptions about methodology that surfaced in the debate. It also suggests ways to improve positive research in accounting choice. The most important of these improvements is tighter links between the theory and the empirical tests. A second suggested improvement is the development of models that recognize the endogeneity among the variables in the regressions. A third improvement is reduction in measurement errors in both the dependent and independent variables in the regressions.

IT is more than a decade since our two papers, "Towards a Positive Theory of the Determination of Accounting Standards" and "The Demand for and Supply of Accounting Theories: The Market for Excuses" were published in *The Accounting Review*. The intervening time allows us to look back on these papers and the ensuing literature with some perspective.

The two papers were controversial ten years ago and remain so today. The papers (primarily Watts and Zimmerman 1978) contributed to a literature that has uncovered empirical regularities in accounting practice (Christie forthcoming; Holthausen and Leftwich 1983; Leftwich forthcoming; Watts and Zimmerman 1986). The empirical regularities have been replicated in different settings

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(Christie forthcoming) and it is clear there is a relation between firms' accounting choice and other firm variables, such as leverage and size and the signs of the relations are mostly consistent across studies. Positive accounting research guided the search for the empirical regularities and provided explanations for them. To date, there are no *systematic* alternative sets of *explanations* for those regularities articulated and tested in the literature. Further, the literature has moved beyond the first simple exposition of the theory in the 1978 paper. The explanation for accounting choice is now richer and more sophisticated.

Our first objective in this paper is to convey our perspective on the evolution and current state of positive accounting theory and to summarize the evidence on systematic empirical regularities in accounting (Section I). The second objective is to evaluate the research methods and the methodology used to document the empirical regularities. We discuss criticisms of the original papers and of the subsequent positive accounting literature in Section II. While the positive accounting literature has explained some accounting practice, much remains unexplained. Our third objective is to provide our views about future directions for positive accounting literature (Section III).

I. Evolution and State of Positive Accounting Theory

Evolution

Modern positive accounting research began flourishing in the 1960s when Ball and Brown (1968), Beaver (1968), and others introduced empirical finance methods to financial accounting. The subsequent literature adopted the assumption that accounting numbers supply information for security market investment decisions and used this "information perspective" to investigate the relation between accounting numbers and stock prices.[1] The "information perspective" has taught us much about the market's use of accounting numbers. But, except for the choice of inventory methods, the "information perspective" has not provided hypotheses to predict and explain accounting choices. The "information perspective" has not provided hypotheses to explain why entire industries switch from accelerated to straight-line depreciation without changing their tax depreciation methods.

An important reason that the information perspective failed to generate hypotheses explaining and predicting accounting choice is that in the finance theory underlying the empirical studies, accounting choice *per se* could not affect firm value. Information is costless and there are no transaction costs in the Modigliani and Miller (1958) and capital asset pricing model frameworks. Hence,

[1] The "information perspective" views accounting data (usually earnings, dividends, and cash flows) as providing information on inputs to valuation models (e.g., discounted cash flows) and tests for associations between accounting disclosures and stock prices or returns. In the contracting approach adopted in the literature and discussed in this paper, accounting methods are primarily determined by the use of accounting numbers in contracts between parties to the firm. Under this approach accounting disclosures directly affect parties' (including stockholders') contractual claims and, hence, the values of those claims (including stock prices). To the extent accounting disclosures are correlated with attributes investors use in valuing securities, these disclosures contain information and affect stock prices. Thus, under both an "information perspective" and a "contracting perspective," accounting disclosures have the potential to alter securities prices (Holthausen forthcoming).

if accounting methods do not affect taxes they do not affect firm value. In that situation there is no basis for predicting and explaining accounting choice. Accounting is irrelevant.

To predict and explain accounting choice accounting researchers had to introduce information and/or transactions costs. The initial empirical studies in accounting choice used positive agency costs of debt and compensation contracts and positive information and lobbying costs in the political process to generate value effects for and, hence, hypotheses about accounting choice. Finance researchers had introduced costs of debt that increase with the debt/equity ratio (Jensen and Meckling 1976) to explain (in combination with differential taxes) how optimal capital structures could vary across industries. The debt costs first introduced were bankruptcy and agency costs. The agency costs were of particular interest to accountants because accounting appeared to play a role in minimizing them. Debt contracts apparently aimed at reducing dysfunctional behavior use accounting numbers (Smith and Warner 1979; Leftwich 1983). Accounting researchers recognized the implications for accounting choice and began using the accounting numbers in debt contracts to generate hypotheses about accounting choice (Watts 1977).[3]

Accounting numbers also are used in manager's compensation contracts and it is hypothesized that such use again minimizes agency costs (Smith and Watts 1982). This use of accounting numbers in bonus plans suggested the possibility that accounting choice could affect wealth and so accounting researchers began employing that use to explain accounting choice. Watts and Zimmerman (1978) is an early example of this approach.

Borrowing from the industrial organization literature in economics (Stigler 1971; Peltzman 1976) which assumes positive information costs and lobbying costs, accounting researchers postulated that the political process generated costs for firms. These political costs are a function of reported profits. Thus, incentives are created to manage reported accounting numbers. Information and lobbying costs are part of the costs of "contracting" in the political process. The extent and form of the wealth transfers created by the political process (such as the tax code) are affected by these contracting costs.

While the early literature concentrated on using debt and compensation contracts and the political process to explain and predict accounting choice, the theory underlying the empirical work was more general and had its foundation in an economic literature on the theory of the firm. Since the 1970s, economists have strived to develop a theory of the firm by attempting to explain the organizational structure of the firm (e.g., choice of corporate form, structure of contracts, management compensation, centralization-decentralization). The underlying notion (Alchian 1950) is that competition among different forms of institutions leads to the survival of those forms most cost-effective in supplying goods and services. Productive activity can occur via the marketplace or by the inclusion of several activities within a firm (Coase 1937; Alchian and Demsetz 1972). In the marketplace, direction of productive activity and cooperation is by market prices; within the firm alternative mechanisms such as standard costs are used (Ball 1989). Which productive activities are carried out by markets and which by firms depends on which arrangement is cost effective.[3] In competition among firms, those that organize themselves to minimize contracting costs are more likely to survive (Fama and Jensen 1983a, 1983b). It was a short step to suggest that accounting methods affect the firm's organizational costs and so the accounting methods that survive are the result of a similar economic equilibrium (Watts 1974, 1977).[4] Accounting researchers have recently returned to using that notion of an efficient set of accounting methods to explain accounting choice (Zimmer 1986).

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[3] Prior to that time other studies investigate accounting choice without explicit recognition of contracting effects (e.g., Gordon 1964; Gordon et al. 1966; Sorter et al. 1966; Gagnon 1967).

As noted above, the agency costs associated with debt and management compensation contracts and the agency, information, and other contracting costs associated with the political process provided the hypotheses tested in the early empirical accounting choice studies (bonus plan, debt/equity, and political cost hypotheses). However, the more general approach suggested agency and other costs associated with other contracts (e.g., sales contracts) could also affect accounting choice.[5] This potential for many contracts to play a role in explaining organizational choice (including accounting choice) and the fact that agency costs used to explain the contracts often arise in contractual scenarios that differ from those of the standard agency problem led researchers to start to use the term "contracting costs" instead of agency costs (Klein 1983; Smith 1980). The concept of contracting costs and the notion of accounting methods as part of efficient organizational technology play key roles in contemporaneous positive accounting theory.

Contemporaneous Positive Accounting Theory

Contracting costs arise in (1) market transactions (e.g., selling new debt or equity requires legal fees and underwriting costs), (2) transactions internal to the firm (e.g., a cost-based transfer price scheme is costly to maintain and can produce dysfunctional decisions), and (3) transactions in the political process (e.g., securing government contracts or avoiding government regulation requires lobbying costs). Contracting costs consist of transaction costs (e.g., brokerage fees), agency costs (e.g., monitoring costs, bonding costs, and the residual loss from dysfunctional decisions), information costs (e.g., the costs of becoming informed), renegotiation costs (e.g., the costs of rewriting existing contracts because the extant contract is made obsolete by some unforeseen event), and bankruptcy costs (e.g., the legal costs of bankruptcy and the costs of dysfunctional decisions). Throughout this paper, we use the term "contracting costs" to incorporate this wide variety of costs. The term "contracting parties" is meant to include all parties to the firm including "internal" employees and managers and "external" parties, such as suppliers, claim holders, and customers.[6]

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[3] Coase (1937) suggests that economies of scale in long-term contracting are what cause activity to be organized in firms. Alchian and Demsetz (1972) point out that those economies are not sufficient since market arrangements could achieve the same economies (e.g., contracting consultants). What is necessary is some unique advantage of firm organization over market arrangements. Alchian and Demsetz suggest it is the advantage firms have in metering inputs to team production that generates firms. Monitors meter individual inputs and the monitors' incentive problem is solved by giving them the residual claim to the firm (hence, the firm structure). Klein et al. (1978) suggest firms emerge to solve post contractual opportunism associated with specialized assets. Meckling and Jensen (1986) suggest that firms have an advantage in generating information by aggregating data and using that information. Difficulties in capturing the information's benefits in the market result in the firm being the optimal form of organization.

[4] Watts adopted such a view in "Accounting Objectives" which he presented to the Annual Congress of the N.S.W. branch of the Institute of Chartered Accountants in Australia in 1974. The paper was later substantially revised given Jensen and Meckling (1976) and joint work with Zimmerman and published in Watts (1977).

[5] The influence of sales contracts on accounting choice is considered by Watts and Zimmerman (1986, 207) and by Zimmer (1986) and joint venture contracts by Zimmer (1986). Further, Ball (1989) suggests intrafirm transactions affect internal accounting choice (e.g., the basis for transfer prices).

The existence of contracting costs is crucial to models of both the organization of the firm and accounting choice. Meckling and Jensen (1986) suggest that within the firm the lack of a market price is replaced by systems for allocating decisions among managers, and measuring, rewarding, and punishing managerial performance. Accounting plays a role in these systems and so appears to be part of the firm's efficient contracting technology. Trying to predict and explain the organization of the firm with zero contracting costs is pointless (Coase 1937; Ball 1989). How the firm is organized, its financial policy, and its accounting methods, are as much a part of the technology used to produce the firm's product as are its production methods. Hence, modelling accounting choice while assuming zero contracting costs is not productive.

The extent to which accounting choice affects the contracting parties' wealth depends on the relative magnitudes of the contracting costs. For example, *assume* accounting-based debt agreements have higher renegotiation costs than accounting-based bonus plans. Then, mandatory changes in accounting procedures by the FASB impose greater relative costs on firms with debt agreements than on firms with bonus plans, *ceteris paribus*. And, firms with debt agreements will conduct more lobbying and undertake more (costly) accounting, financing, and production changes to undo the effects of the mandatory change than firms with only bonus plans. Thus, developing a positive theory of accounting choice requires an understanding of the relative magnitudes of the various types of contracting costs.

Contracts that use accounting numbers are not effective in aligning managers' and contracting parties' interests if managers have complete discretion over the reported accounting numbers. If managers know (or can determine) which accounting methods best motivate subordinates, then the contracting parties want managers to have some discretion over the accounting numbers. Hence, we expect some restrictions on managers' discretion over accounting numbers, but some discretion will remain. When managers exercise this discretion it can be because (1) the exercised discretion increases the wealth of all contracting parties, or (2) the exercised discretion makes the manager better off at the expense of some other contracting party or parties. If managers elect to exercise discretion to their advantage *ex post*, *and* the discretion has wealth redistributive effects among the contracting parties, then we say the managers acted "opportunistically."

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[6] See Watts (1974) for an earlier and Ball (1989) for a later discussion of contracting parties other than capital suppliers and managers.

Ex ante, the set of accounting choices restricted by the contracting parties is determined by "efficiency" reasons (to maximize firm value). One cost of allowing managers more rather than less discretion is the increased likelihood of some *ex post* managerial "opportunism" (i.e., wealth transfers to managers) via accounting procedures. However, *ex ante* the contracting parties expect some redistributive effects and reduce the price they pay for their claims. *Ex post*, wealth is redistributed by managerial opportunism, but *ex ante* some redistribution was expected and the parties price protected themselves. Price protection does not eliminate the incentive to act opportunistically nor does price protection eliminate the dead weight costs of managers taking opportunistic actions. The extent to which contracts can be written *ex ante* to preclude such *ex post* behavior that causes dead weight costs increases the chance the firm will survive in a competitive environment (Klein 1983, fn. 2).

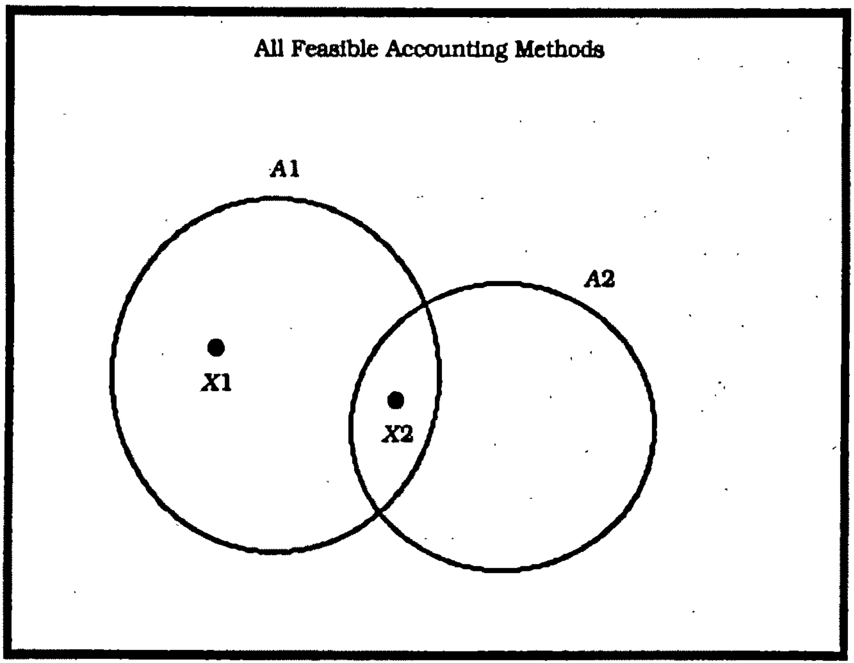
The set of accounting procedures within which managers have discretion is called the "accepted set." It is voluntarily determined by the contracting parties. Managerial discretion over accounting method choice (i.e., the "accepted set") is predicted to vary across firms with the variation in the costs and benefits of restrictions. These restrictions produce the "best" or "accepted" accounting principles even without mandated accounting standards by government. The restrictions are enforced by external auditors. Reacting to the incentive of managers to exercise accounting discretion opportunistically, the accepted set includes "conservative" (e.g., lower of cost or market) and "objective" (e.g., verifiable) accounting procedures (Watts and Zimmerman 1986, 205–206).

Figure 1 represents the concept of the "accepted set" of accounting methods as a Venn diagram. $A1$ denotes the accepted set of methods for firm 1. *Ex ante*, the accepted set is determined jointly by the contracting parties to maximize the value of the firm (e.g., set $A1$ vs. $A2$ in Fig. 1). Managers have discretion to choose any method within the accepted set (e.g., $X1$). Also, managers in firm 2 are constrained *ex ante* to the set $A2$ and choose $X2$ *ex post*. For example, within the accepted set of procedures used for bonus plans managers might select the method that maximizes their utility, even if it comes at another contracting party's expense. Managers' *ex post* choice can either increase the wealth of all contracting parties or redistribute wealth among the parties. Empirically, it is difficult to separate *ex ante* from *ex post*. Contracts are continually being written, rewritten, and revised.

Variations across sets of accepted accounting procedures (e.g., $A1$ and $A2$ in Fig. 1) explain some cross-sectional variation in accounting choice (e.g., managers in firm 2 cannot choose method $X1$). For example, Zimmer (1986) argues Australian real estate development firms are restricted by accepted practice from capitalizing interest except for cost plus contracts that allow interest as a cost. His evidence is consistent with that hypothesis.

Most accounting choice studies assume managers choose accounting methods to transfer wealth to themselves at the expense of another party to the firm because they can take the firm's observed contracts as given and then determine managers' incentives for accounting choice. Some research studies assume accounting methods are chosen for efficiency reasons (i.e., they increase the pie available being shared among all parties to the firm (Watts 1974, 1977; Leftwich

Figure 1
Relation Between the Accepted Set of Accounting Methods and the Choice of Method from within the Accepted Set



*A*1 denotes the set of accepted methods for firm 1
*A*2 denotes the set of accepted methods for firm 2
*X*1 denotes the choice of method from within the accepted set by firm 1
*X*2 denotes the choice of method from within the accepted set by firm 2

et al. 1981; Zimmer 1986; Whittred 1987; Ball 1989; Malmquist forthcoming; Mian and Smith forthcoming). However, no study to date has explained both the *ex ante* choice of the accepted set and the *ex post* choice of accounting method from within the accepted set. Most studies that assume opportunistic choice of accounting methods do not control for the fact that managers in different firms likely are choosing accounting methods from different constrained accepted sets.

The accepted set of accounting methods is one part of the firm's implicit and explicit contracts including the firm's capital structure, compensation plans, and ownership structure. All the contracting provisions (including the accounting policies) are endogenous. Capital structure choice is related to compensation policy and to accounting policy. But, the relation is not necessarily causal. Capital structure changes do not *cause* changes in the accepted set of accounting methods. Rather, some exogenous event, such as a new invention or government deregulation occurs and this causes changes in the contracting variables including accounting methods (Ball 1972; Smith and Watts 1986).

Evidence on the Theory

Two types of tests of the theory have been conducted: stock price tests and accounting choice tests. The stock price tests have been reviewed extensively elsewhere (Foster 1980; Ricks 1982; Holthausen and Leftwich 1983; Lev and Ohlson 1982; Watts and Zimmerman 1986; Bernard 1989). Stock price tests of the theory reveal some price reactions to mandatory accounting changes, especially involving oil and gas accounting (Lys 1984).[7] Stock price studies are probably relatively weak tests of the theory (Watts and Zimmerman 1986). The more promising ones are accounting choice studies.

Most accounting choice studies attempt to explain the choice of a single accounting method (e.g., the choice of depreciation) instead of the choice of combinations of accounting methods. Focusing on a single accounting method reduces the power of the tests since managers are concerned with how the combination of methods affects earnings instead of the effect on just one particular accounting method (Zmijewski and Hagerman 1981). Some studies seek to explain accounting accruals (the difference between operating cash flows and earnings). Accounting accruals aggregate into a single measure the net effect of all accounting choices (Healy 1985; DeAngelo 1986, 1988a; Liberty and Zimmerman 1986). But use of accruals as a summary measure of accounting choice suffers from a lack of control of what accruals would be without managerial accounting discretion.

Most accounting choice studies use combinations of three sets of variables: variables representing the manager's incentives to choose accounting methods under bonus plans, debt contracts, and the political process. Bonus plan and debt contract variables are used because they're observable. The three particular hypotheses most frequently tested are the bonus plan hypothesis, the debt/equity hypothesis, and the political cost hypothesis. The literature has tended to state each of these hypotheses as managers behaving opportunistically. The bonus plan hypothesis is that managers of firms with bonus plans are more likely to use accounting methods that increase current period reported income. Such selection will presumably increase the present value of bonuses if the compensation committee of the board of directors does not adjust for the method chosen.

The choice studies to date find results generally consistent with the bonus plan hypothesis (Watts and Zimmerman 1986, chap. 11; Christie forthcoming).

[7] Using Lys' own calculations, Frost and Bernard (1989, 20) and Bernard (1989, 14) conclude Lys' evidence is inconsistent with a link between stock price reactions to mandated oil and gas accounting and the violation of debt covenants. However, that conclusion is unwarranted. Lys estimates the average cost of violations as 2.5 percent of the stock value, the same order of magnitude as the stock price reactions observed. Frost and Bernard argue that given an average cost of violation of 2.5 percent, the average stock price reaction should be much less since according to Foster (1980) very few firms have a debt covenant violation as a result of the mandated accounting change. There are at least three problems with the Frost and Bernard argument. First, the Lys point estimates are likely to have large standard errors. Second, to obtain an estimate of the stock price reaction, the estimated cost of a violation has to be weighted not by the relative frequency of violation but by the change in the likelihood of violation. While few firms violated covenants, many firms' probability of violation likely increased substantially. Third, Malmquist (forthcoming) suggests Foster's description of oil and gas firms' covenants is incorrect. Frost and Bernard (1989) also use their own empirical study's results to argue that there is no link between the stock price reaction and debt covenants. Because of selection biases, however, their study provides little evidence on the issue (Begley forthcoming).

The early tests of the bonus hypothesis are not very powerful tests of the theory because they rely on simplifications of the theory that are not appropriate in many cases. For example, a bonus plan does not always give managers incentives to increase earnings. If, in the absence of accounting changes, earnings are below the minimum level required for payment of a bonus, managers have incentive to reduce earnings this year because no bonuses are likely paid. Taking such an "earnings bath" increases expected profits and bonuses in future years. By using bonus plan details to identify situations where managers are expected to reduce earnings, Healy's (1985) tests encompass more kinds of manipulation. His results are consistent with managers manipulating net accruals to affect their bonuses.

The debt/equity hypothesis predicts the higher the firm's debt/equity ratio, the more likely managers use accounting methods that increase income. The higher the debt/equity ratio, the closer (i.e., "tighter") the firm is to the constraints in the debt covenants (Kalay 1982). The tighter the covenant constraint, the greater the probability of a covenant violation and of incurring costs from technical default. Managers exercising discretion by choosing income increasing accounting methods relax debt constraints and reduce the costs of technical default.

The evidence is generally consistent with the debt/equity hypothesis.[8] The higher firms' debt/equity ratios, the more likely managers choose income increasing methods. Press and Weintrop (forthcoming) and Duke and Hunt (forthcoming) find that debt/equity ratios are correlated with closeness to bond covenants as assumed in the debt/equity hypothesis.[9] Some studies, however, have avoided using the debt/equity ratio as a proxy variable for closeness to the covenant constraint by using more direct tests. For example, Bowen et al. (1981) examine whether accounting choice varies with tightness of the dividend constraint as specified in the debt covenant and measured by "unrestricted retained earnings." The association between leverage and accounting method choice is an empirical regularity unknown prior to the positive accounting studies.

The political cost hypothesis predicts that large firms rather than small firms are more likely to use accounting choices that reduce reported profits. Size is a proxy variable for political attention. Underlying this hypothesis is the assumption that it is costly for individuals to become informed about whether accounting profits really represent monopoly profits and to "contract" with others in the political process to enact laws and regulations that enhance their welfare. Thus, rational individuals are less than fully informed. The political process is no different from the market process in that respect. Given the cost of information and monitoring, managers have incentive to exercise discretion over accounting profits and the parties in the political process settle for a rational amount of *ex post* opportunism.

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[8] Holthausen (1981) and Healy (1985) fail to reject the null hypothesis of no association between leverage and accounting method choice (see Christie forthcoming, table 1).

[9] Researchers are beginning to distinguish between how close the firm is to a given covenant constraint versus the existence of the covenant. For example, Press and Weintrop (forthcoming) find the existence of a covenant has additional explanatory power in a model predicting accounting choice after including a leverage variable.

The evidence is consistent with the political cost hypothesis. However, the result only appears to hold for the largest firms (Zmijewski and Hagerman 1981) and is driven by the oil and gas industry (Zimmerman 1983). Difficulties with using firm size to proxy for political costs, including the likelihood that it can proxy for many other effects, such as industry membership, are discussed in Ball and Foster (1982). The interesting finding is the consistency of the sign of the relation between size and accounting choice across a variety of studies. The largest firms tend to use income decreasing accounting methods. Presently, there is no alternative theory for the empirical regularity between firm size and accounting choice other than the political cost hypothesis.

Bonus plan, debt contract, and political process variables other than bonus plan existence, leverage, and size have also been found to be associated with accounting choice. Christie (forthcoming) aggregates test statistics across the various studies and concludes "... six variables common to more than one study have explanatory power. These variables are managerial compensation, leverage, size, risk, and interest coverage and dividend constraints. Another conclusion is that the posterior probability that the theory taken as a whole has explanatory power is close to one."

While bonus, debt, and political process variables tend to be statistically significant (*p*-values smaller than .10), in many studies the explanatory power (R^2) of the models is low. In Zmijewski and Hagerman (1981), the model of cross-sectional choice of accounting methods is not significantly better than picking the most common combination, although Press and Weintrop (forthcoming) achieve slightly improved explanatory power. The alternative predictive model is that each firm uses the most common combination of accounting methods, a model with little explanatory appeal. The alternative model begs the question of what determines the majority accounting choice. Many accounting teachers would be uncomfortable with the explanation that managers choose their accounting procedures based on what most other firms are doing. The real issue is the lack of an alternative model with greater explanatory power, not the low explanatory power of the extant theory. Several problems with the existing research methods contribute to the low explanatory power. These are discussed next.

II. Criticisms of Positive Accounting Research

Table 1 lists most of the published papers with critical comments on our 1978 and 1979 papers. The second and third columns list the number of explicit references made by the authors to our 1978 and 1979 papers. These columns indicate which of the two papers is the primary focus of the article. The fourth column lists the general topic of the paper and the fifth column lists the major criticisms raised in the paper.

The criticisms in Table 1 can be dichotomized into two mutually exclusive sets: those concerning research methods (including the inferences drawn) and those concerning methodology (including the philosophy of science). For example, Ball and Foster (1982), Holthausen and Leftwich (1983), and McKee et

Table 1
Summary of Papers Reviewing Watts and Zimmerman (1978 and 1979)

	Number of References			
Authors	*WZ (1978)*	*WZ (1979)*	*Topic*	*Major Criticisms*
Ball and Foster (1982)	13	1	Review of Empirical Accounting Research	• Firm size and bonus plans can proxy for omitted variables • Weak theoretical underpinning for size-political cost construct • Holdout sample not used
Tinker et al. (1982)	1	4	Positive versus normative theories	• Positive theories are value-laden and mask a conservative bias • Ignores underlying class struggles
Christenson (1983)	6	9	Methodology of Positive Accounting	• Logical Positivism is an obsolete methodological approach • Approach is a "sociology of accounting" instead of accounting theory • Tests introduce *ad hoc* arguments to excuse the exceptions to the theory • Inappropriate methods are used for constructing explanatory theories
Holthausen and Leftwich (1983)	7	0	Review of "Economic Consequences Literature"	Interpretation of results limited because: • Incomplete political and contracting theories • Specification problems in left-hand-side and right-hand-side variables
Lowe et al. (1983)	0	12	WZ (1979)	• Economic framework is unjustified • Positive approach open to dispute • Nature of proof is unscientific • Contrary evidence presented

TABLE 1—*Continued*

	Number of References			
Authors	*WZ (1978)*	*WZ (1979)*	*Topic*	*Major Criticisms*
McKee et al. (1984)	4	0	Replication of WZ (1978)	• Results do not hold in a new sample • Holdout sample not used • Foreknowledge of sample proportions biases parameter estimates
Whittington (1987)	0	7	Review of WZ (1986)	• Presentation of arguments and evidence is unbalanced • Extreme methodological stance • Positive theories are value-laden • Approach is a "sociology of accounting" instead of accounting theory
Hines (1988)	4	0	Christenson (1983) and Methodology	• Popper is not a practical evaluative guideline for empirical accounting research

al. (1984)[10] discuss research methods problems and not philosophy of science issues. The remaining authors concentrate on philosophy of science issues to the near exclusion of problems with research methods. Except for Holthausen and Leftwich (1983), all the reviews of positive accounting ignore the accumulating body of evidence consistent with the theory. For example, Hines (1988) cites McKee et al. (1984) as contradictory evidence to Watts and Zimmerman (1978). Yet, she ignores 21 studies reviewed in Watts and Zimmerman (1986, chaps. 11, 12) and Christie (forthcoming) that present evidence generally consistent with the theory.

The research method issues are important and future research must attempt to address them. However, it is unlikely that the positive accounting literature or any other empirical literature will ever totally eliminate such issues. We do not agree with many of the philosophy of science issues raised and seek to eliminate the common misconceptions they reflect. Research method issues, some raised by others and some by us, are discussed first in this section and philosophy of science issues are discussed second.

Research Method Issues

The first research method issue involves the tests' lack of power. The second issue involves the possibility that the results obtained in the positive accounting literature are due to unrecognized alternative hypotheses, not the stated hypotheses.

Reductions in the tests' power. Tests of the theory lack power for several reasons: problems with model specification, problems specifying the left-hand-side and right-hand-side variables, and omitted variables. Each of these are discussed next.

Model specification. All the studies to date have assumed accounting choice results either from efficiency reasons or managerial opportunism. This produces two model specification errors. First, in probit type regressions where the choice of accounting method depends on the effect of the choice on the manager's wealth, the right-hand-side or explanatory variables reflect the wealth effects of the choice via compensation plans, debt agreements, and the political process. Implicitly researchers are holding constant the firm's investment opportunity set and contracts and interpret the compensation plan variable as managerial opportunism. But, the debt and political variables can represent both efficiency and opportunism. Thus, the model is misspecified. The second specification error results from ignoring the interaction effects among the right-hand-side variables. Higher earnings impose political costs and so reduce the size of the pie for the contracting parties and at the same time increase the manager's bonus compensation. The manager's increased share of the smaller pie might be larger than a smaller share of the larger pie. The bonus plan and political process effects interact. However, in the empirical models the right-hand-side variables are treated as additive and interaction effects are ignored. Solving these two specification problems requires researchers to specify the intertemporal interaction between opportunism (including managerial reputation incentives) and efficiency effects (see Christie 1987).

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[10] McKee et al. (1984) discuss problems of the tests in Watts and Zimmerman (1978), extend the tests to another sample of firms, and offer some statistical refinements. The only satistically significant explanatory variable in our 1978 paper was firm size. McKee et al. find that their refined measure of firm size, (SALES/MAXSALES)DTREND, is statistically significant in both our sample and their sample and remains statistically significant after various refinements are made. They do not discuss the importance of this finding.

Left-hand-side variable. Problems specifying the accounting choice variable reduce the power of the tests. One such problem mentioned earlier is the use of single method choices as the left-hand-side variable. Zmijewski and Hagerman (1981) and Press and Weintrop (forthcoming) use sets of accounting methods and still achieve relatively low explanatory power. However, ranking the effects of various portfolios of accounting methods on earnings requires assumptions about the relative effects on earnings of the various accounting choices (e.g., the effect of depreciation choice vs. inventory choice). These assumptions induce error in the left-hand-side variable. Healy (1985) tries to overcome this problem by using net accruals as his left-hand-side variable. But, the variable "net accruals" is a noisy measure of the net accruals manipulated by managers. Some accounting decisions that affect accruals have been made earlier and are probably beyond the manager's discretion at the time of the measurement. Ideally, net accruals should be measured relative to what they would be without manipulation, so these variations are excluded from the left-hand-side variable. This requires a model of accruals that currently does not exist (Moyer 1988; McNichols and Wilson 1988; DeAngelo 1988b).

Right-hand-side variables. Some variables in accounting choice studies are mismeasured. For example, both the closeness to the covenant (i.e., the difference between the number specified in the covenant and the actual number) and the existence of the covenant are likely important determinants of accounting choice. But the debt/equity ratio by itself is an imprecise measure of both closeness to the constraint and the existence of a constraint. Also, the use of a zero-one variable to measure a bonus plan effect is simplistic. Ball and Foster (1982, 184) point out that other components of pay, such as salary, can depend on accounting earnings without a formal compensation plan and that even with a formal accounting-based plan the outside directors can adjust the incentive pay for accounting changes. However, finding an association between an indicator variable representing a bonus plan and choice of accounting methods is informative and suggests that further research with more refined measures based on the bonus plans' details will yield stronger results than the zero-one variable. Also, more direct measures of political sensitivity than firm size (Wong 1988; Jones 1988; Sutton 1988) provide more powerful tests of the political cost hypothesis.

Omitted variables. There are three different omitted variable problems in the current literature: omitting standard accounting-based contracts, omitting less standard contracts, and omitting variables representing the accepted set. First, contracting cost variables for standard contracts, such as bonus plans occasionally are omitted because such variables are costly to collect. For example, Daley and Vigeland (1983) omit a variable representing accounting-based management compensation plans from their regression. Because leverage, compensation contracts, and accounting policy are part of the firm's efficient contracting technology, these variables covary and also vary with firm size. Omitting a right-hand-side variable correlated with included variables causes the existing right-hand-side variables to become surrogates for the omitted variables. This produces biased coefficients of the estimated right-hand-side variables and hampers their interpretation.

A second omitted variables problem is that to a large degree, the literature to date focuses only on debt and compensation contracts. Other contracts influence management's choice of accounting methods, but these are omitted in most tests. For example, the existence of a bonus plan is likely correlated with other organizational devices such as stock option plans. These other organizational structures might be driving the accounting choice rather than bonus plans (Ball and Foster 1982, 185). And, it is incorrect to ascribe all the explanatory effect of the bonus plan indicator variable results to the bonus plan. Corporate control issues also are often omitted as explanatory variables in seeking to explain accounting choices. DeAngelo (1988a) finds that net accruals are more positive (i.e., higher reported earnings) during proxy fights. Zimmerman (1979) and Ball (1989) argue that accounting numbers are part of the internal control process and, thus, affect manager's choice of accounting methods (e.g., cost allocations). Ignoring these, other less frequently researched informal contracts can produce biased coefficients.

Third, as discussed under specification problems above, the left-hand-side variable in most studies is the manager's choice of accounting methods. Even without a government regulatory defined set of accounting methods, this choice is made from within the "accepted set of methods" (see Fig. 1).[11] Yet, most studies do not control for differences across firms' accepted sets. Such control requires a theory of how the sets of accepted accounting methods vary and such a theory does not exist. Failure to control for differences in accepted sets induces another correlated omitted variables problem in the tests. The severity of this correlated omitted variables (and model specification) problem is likely to be larger in studies in which the sampled firms are drawn from several industries than in studies where the sampled firms are drawn from the same industry.

Alternative hypotheses. Alternative hypotheses can explain the bonus, debt/equity, and size results found in the positive accounting literature. Several scenarios illustrate how this problem might arise:

1. If the accounting system is part of the firm's efficient set of implicit and explicit contracts, accounting choice is endogenous. Contracting, investment, and production decisions are determined jointly. The type of contracts used (including the accounting methods) depends on the firm's investment opportunity set. Hence, the firm's investment opportunity set (e.g., whether it includes growth options or not) is correlated with the firm's financial, dividend, compensation, and accounting policies. Smith and Watts (1986) find significant cross-sectional correlations among

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[11] Mian and Smith (forthcoming) find that accounting policy decisions regarding consolidations vary by type of organization structure. Consumer finance subsidiaries are more prevalent where the parent is in the financial services industry and choice of consolidation is more homogeneous within like organization structures than in dissimilar structures. Also, operating interdependencies between the parent and subsidiary drive some accounting choices.

firms' investment opportunity sets, financial policies, dividend policies, and compensation policies. The documented correlations between debt/equity and accounting choice and between bonus plans and accounting choice could be due to the correlation between financial and compensation policies and the optimal set of accounting procedures for contracting. Most researchers, however, interpret these associations as resulting from opportunistic actions by managers and have not considered efficiency-based hypotheses.

2. Accounting choice also is endogenous in the political process. The potential costs of a proposed accounting standard affect the standard before it is released. The correlation between financial and compensation policies and accounting policy is likely affected by the firm's tax accounting policies. While some financial accounting method choices do not affect taxes, reducing bookkeeping costs by keeping one set of books and the possibility that tax audits or future taxes might be levied using reported income induce a relation between financial accounting and tax accounting methods.[12]

One cannot test claims that variables like debt/equity and size are surrogates for alternative explanations until those alternatives are identified and the relation specified. Given the investment opportunity set and taxes are identified as possible explanatory variables, future research can investigate their implications as alternative hypotheses to those currently advanced. For example, changing accounting methods can result from a change in the firm's investment opportunity set causing the efficient contracts and accounting methods to change. Or, some exogenous event occurs (such as reduced demand for the firm's products) and managers take opportunistic actions to undo the adverse compensation and debt contract effects of the exogenous event. Accounting changes likely are due to both efficiency reasons and managerial opportunism. Probing the relative importance of efficiency and opportunism for accounting method changes requires more refined theories and more linkage between the theory and the tests.

Philosophy of Science Issues

Positive theories are value-laden. Tinker et al. (1982, 167) argue that all research is value-laden and not socially neutral. Specifically, "Realism, operating in the clothes of positive theory, claims theoretical supremacy because it is born of fact, not values" (p. 172). We concede the importance of values in determining research; both the researcher's and user's preferences affect the process.

Competition among theories to meet users' demands constrains the extent to which researcher values influence research design. Positive theories are "If . . . , then . . ." propositions that are both predictive and explanatory. Researchers choose the topics to investigate, the methods to use, and the assumptions to make. Researchers' preferences and expected payoffs (publications and citations) affect their choice of topics, methods, and assumptions. In this sense, all research, including positive research is "value-laden." The usefulness of positive theories depends on their predictive and explanatory power and on the user's preferences or objective function. To the extent that the researcher's values interfere with the theory's ability to predict and explain, the theory's usefulness is reduced.

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[12] The Corporate Alternative Minimum Tax under the Tax Reform Act of 1986 requires a portion of reported income be in the tax base. This act increases the tax incentives on financial reporting. Research to date has not documented the effect of 1986 tax reform on financial reporting incentives.

Approach is a "sociology of accounting" instead of accounting theory. Christenson (1983, 5) writes, "The program of the Rochester School is concerned with describing, predicting, and explaining the behavior of accountants and managers, not that of accounting entities." His definition of an "accounting entity" is "A business enterprise or other economic unit, or any subdivision thereof for which a system of accounts is maintained" (Kohler 1975, 14). Christenson (1983, 6) supports his criticism with an analogy from the physical sciences, "Chemical theory consists of propositions about the behavior of chemical entities (molecules and atoms) not about the behavior of chemists." In chemistry, chemical reactions exist without chemists and one can study reactions without studying chemists. But, there would be no accounting without accountants, managers, or preparers of the numbers; there would be no numbers or systems to investigate because people "*maintain*" the system (Lavoie 1989). Analogously, there would be no study of political science if politicians and voters were ignored.

The study of accounting (or political science) is a social science (Christenson 1983, fn. 5). An accounting theory that seeks to explain and predict accounting cannot divorce accounting research from the study of people. The contracting approach to studying accounting requires researchers to understand the incentives of the contracting parties.

Inappropriate methods are used for constructing explanatory theories. We apply traditional, generally accepted research methods and methodology from accounting, finance, and economics. Christenson (1983, 6) states, "The Rochester School has drawn its concept of 'positive theory' from that guru of the Chicago School of Economics, Milton Friedman."[13] Whittington (1987, 331) states, ". . . Watts and Zimmerman are not unique in owing intellectual allegiance to the Chicago view. . . . The majority of North American empirical accounting researchers would fall into this category, and their collective achievements are formidable."

The economic approach we and many others use applies a simple proposition: To predict and explain individual behavior, people (including accountants, regulators, and researchers) consider the private costs and benefits (broadly defined) of an action and choose the action if the benefits exceed the costs. This economics-based research methodology may be fundamentally flawed in ways we do not now understand. But, accounting research using this methodology has produced useful predictions of how the world works (e.g., association between earnings and stock prices, random walk model of earnings, contracting and size variables associated with accounting choice). A methodology that yields useful results should not be abandoned purely because it *may* not predict *all* human behavior. Do we discard something that works in some situations because it *may* not work in every circumstance? Despite what the critics think methodology *should be*, the methodologies that survive are the ones that produce useful theories. Competition in the marketplace of ideas will produce future research that uncover the errors of our present ways. Time will tell whether our approach is inappropriate.

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[13] Christenson is referring to Milton Friedman's views on scientific methodology as expounded in Friedman (1953). In our opinion, Friedman places too much emphasis on prediction vis-á-vis explanation.

Choice of the term "Positive Accounting Theory." Positive accounting research existed long before the publication of our 1978 and 1979 papers. Early examples include Gordon (1964), Gordon et al. (1966), and Gagnon (1967). We applied the label "positive" to a set of existing research studies. The prime reason we attached this adjective in "Towards a Positive Theory of the Determination of Accounting Standards" was to emphasize that accounting theory's role is to provide explanations and predictions for accounting practice.

In Watts and Zimmerman (1986, 2) we state the objective of an accounting theory is to explain and predict accounting practice. Neither prediction nor explanation is preeminent. We adopted the label "positive" from economics where it was used to distinguish research aimed at explanation and prediction from research whose objective was prescription. Given the connotation already attached to the term in economics we thought it would be useful in distinguishing accounting research aimed at understanding accounting from research directed at generating prescriptions. In the 1960s researchers were still debating various normative theories of accounting (Chambers 1966; Sprouse and Moonitz 1962).

Our use of the term "positive" differentiated our and other people's (positive) research from traditional normative theories by emphasizing the importance of prediction and explanation. It helped place normative theories and their role in a clearer perspective. Our work was not directly related to the debate over alternative normative theories and we wanted to differentiate our work from that debate. The phrase "positive" created a trademark and like all trademarks it conveys information. "Coke," "Kodak," "Levis" convey information. A positive theory differs from a normative theory, though a positive theory can have normative implications once an objective function is specified (Jensen 1983).

In retrospect, the term "positive" generated more confusion than we anticipated. For example, some thought we meant logical positivism (Christenson 1983). We merely intended to distinguish positive propositions from the extant normative propositions in the literature. While the term "positive" avoided debates over normative uses of the work, the term "positive" generated considerable debate over philosophical issues.

Despite its problems, we prefer "positive accounting literature" to alternative terms that have arisen, particularly the term "economic consequences literature." This latter term suggests accounting standards are decided on some higher basis and that economic consequences are a secondary factor only considered after the initial decision is made on the higher basis.[14]

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[14] Some have suggested the term "contracting theory." While descriptive of most of the elements in the existing theory, it seems to preclude noncontractual variables that might be discovered later (e.g., taxes or information for the capital markets, Holthausen forthcoming).

Debate over methodology. Several papers listed in Table 1 involve a debate over what constitutes "proper" methodology (Tinker et al. 1982; Christenson 1983; Lowe et al. 1983; Whittington 1987; Hines 1988). For example, Christenson (1983, 1) concludes, ". . . [T]he standards advocated by the Rochester School for appraisal of their own theories are so weak that those theories fail to satisfy Popper's (1959) proposal for demarking science from metaphysics." Hines (1988) then criticizes Christenson for relying on Popper (1959) which later philosophers of science have questioned. Hines (1988, 658) argues these methodology issues are important and if ignored will "harmfully limit the nature and domain of accounting research."

The methodology criticisms have failed the market test because they have had little influence on accounting research. Researchers have not changed their approach. Referees and editors of journals have not asked researchers to alter their methodology based on these published critiques. There are at least three reasons these criticisms have had little effect on published research. First, the criticisms are written in an abstract fashion. Instead of just criticizing extant papers, if the critics would repeat studies without making the alleged errors, then users of the corrected research would demand such procedures be followed in the future. If the alleged errors are important to users, then other researchers, editors, and referees would adopt the suggestions. Second, critics who place unreasonable demands on studies cause other researchers to disregard their complaints. For example, Hines (1988, 661) argues that Watts and Zimmerman (1978) should have: (1) avoided crude proxies, (2) avoided unrealistic assumptions, (3) investigated the anomalies, (4) clarified their theories, and (5) rigorously tested their theories against competing hypotheses. All these standards are relevant, but if all were applied rigorously to individual papers (especially early papers in an area of thought), no research would be published. Third, to most researchers, debating methodology is a "no win" situation because each side argues from a different paradigm with different rules and no common ground. Our reason for replying here is that some have mistaken our lack of response as tacit acceptance of the criticisms.

III. Summary and Conclusions

Our prime objective in this paper is to provide a perspective on our 1978 and 1979 *Accounting Review* papers. The 1978 paper has proven more important than the "Excuses" paper. Based on citations, the 1978 paper has received over three times as many citations as the 1979 paper (Brown and Gardner 1985, 97). The 1978 paper was a catalyst for research into the choice of accounting methods. Except for generating debates over methodology, the 1979 "Excuses" paper has remained outside the mainstream of accounting research probably because of the more subjective type of evidence necessary to test theories of the effect of accounting research on policy.

The debate over methodology has been less useful than the discovery and explanation of empirical regularities. The positive accounting literature has discovered several empirical regularities in accounting choice and provided an explanation for them. Critics of the 1978 and 1979 papers raise issues involving research methods and philosophy of science. The methodology we and the subsequent literature use is the methodology of economics, finance, and science generally. This methodology has been successful in accounting and we feel no necessity to apologize for it. Under this methodology, a theory is not discarded merely because of some inconsistent observations. The best theory is determined in a competition to meet the demand from students and practitioners for theories that explain and predict accounting choice. It is unlikely an accounting or a social science theory with perfect predictions will ever exist. Researchers are influenced by their values. But, to the extent those researchers are competing to meet student and practitioners' demand for theories, they have incentives to reduce that influence. Further, the careful dichotomy between theory and prescription helps reduce that influence. Lastly, accounting is an activity carried out by people and one cannot generate a theory that predicts and explains accounting phenomena by ignoring the incentives of the individuals who account. In this final section we summarize the contributions made by this literature, our views on promising research directions, and some conclusions.

Positive Accounting Literature Contributions

Discovering systematic patterns in accounting choice outlined in the preceding sections and providing specific explanations for the patterns are the literature's major contributions. However, we believe the literature has made other contributions: it provides an intuitively plausible framework for understanding accounting. A plausible framework is a useful pedagogy for teaching accounting. The literature also encourages researchers to address accounting issues and emphasizes the central role of contracting costs in accounting theory.

The literature explains why accounting is used and provides a framework for predicting accounting choices. Choices are not made in terms of "better measurement" of some accounting construct, such as earnings. Choices are made in terms of individual objectives and the effects of accounting methods on the achievement of those objectives. For example, some accounting instructors teach that certain accounting methods (e.g., current cost) are better than others (e.g., historical cost). But, no explanation is offered why these "better" measures are not adopted. The positive accounting literature takes as given the proposition that the accepted set maximizes the wealth of the contracting parties and then seeks to understand how wealth is affected by specific accounting methods.

The literature's emphasis on predicting and explaining accounting phenomena encourages research that is relevant to accounting. One of the first questions one pursuing this approach asks of a new model is whether it has any relevance to predicting and explaining accounting practice.

Another contribution of the literature is to highlight the importance of contracting costs (including information, agency, bankruptcy, and lobbying costs). Contracting costs have long been important in economics and date to Coase (1937). Positive accounting research has more recently recognized the importance of contracting costs to explain accounting. In the late 1960s and 1970s, financial economists derived pricing models (capital asset pricing models, option pricing models, arbitrage pricing models). These models were developed under assumptions of costless information and such models explain why different securities sell for different relative prices. Such models do not explain institutional differences, such as open- and closed-end mutual funds. To explain such institutional differences requires assumptions of costly information and contracting. Likewise, accounting would not exist without contracting costs and so it is difficult to produce a theory that predicts and explains accounting without making assumptions about the relative magnitudes of these costs. The central role of contracting costs highlighted by positive accounting research makes it difficult to ignore these costs in accounting theories. It directs researchers' attention to the appropriate issues.

Future Research Directions

Section II discussed two major research methods issues: the lack of power of the tests and alternative economic explanations for the empirical regularities. The following research suggestions focus on these two issues. We believe these suggestions will be more fruitful in advancing the understanding of accounting choice than "merely conducting more studies using existing formulations of the theory and existing ways of measuring variables" (Christie forthcoming) (also see Holthausen and Leftwich 1983, 109–114).

First, the single most important task facing positive accounting researchers is improving the linkage between the theory and empirical tests. The theory predicts that the magnitude of debt renegotiation costs will affect managers' choice of accounting methods and will set an upper bound on the magnitude of the default costs. To date, researchers have been unable to document the magnitude of the costs imposed by a technical violation of a debt covenant or the magnitude of renegotiation costs (Holthausen 1981; Leftwich 1981; Lys 1984; Leftwich forthcoming). Greater attention has to be placed on developing a unified theory that incorporates both the *ex ante* efficient restrictions on the managers' accepted set of accounting methods and the *ex post* exercise by managers of their discretion to choose accounting methods from within the accepted set. The empirical tests can no longer assume accounting choice is made for either efficiency or opportunistic reasons. Both must be incorporated into the tests. Also, estimates of the relative magnitudes of the various components of contracting costs can help to further refine the linkage between the theory and tests by identifying those costs most influential in driving accounting choice.

Developing and testing alternative hypotheses for the existing empirical regularities also will enhance the linkage between the theory and the tests. Hypotheses can be developed to predict new empirical regularities. Under the contracting approach, debt and compensation contracts are only some of the contracts that affect firms' cash flows. Other (explicit and implicit) contracts can be used to develop new predictions (DeAngelo 1988a). Particularly promising is the effect of accounting procedures for internal control on external reporting (Ball 1989). For example, Mian and Smith (forthcoming) find that the prevalence of consolidated reporting of financing subsidiaries depends on the extent to which the subsidiary is interdependent with the parent's main business. How the firm is organized internally (e.g., functionally or by product line), the type of internal compensation systems, and the investment opportunity set are likely associated with the type of internal accounting performance measurement systems. Internal contracting parties may well turn out to be as important a determinant of external financial reporting as the external contracting parties.

Finally, the political process can affect firms' cash flows other than via the simple political cost hypotheses. More detailed specification of government regulatory processes that rely on accounting numbers can be used to develop new hypotheses and a tighter linkage between the theory and tests by suggesting more precise proxy variables other than firm size (Sutton 1988; Wong 1988; Jones 1988).

Second, when accounting choice is cast as part of the efficient contracting technology, variables often used to explain and predict accounting choice are endogenous. For example, changes in accounting procedures occur simultaneously with changes in the firm's investment opportunity set, its financial and compensation contracts, its organizational structure, and even in its political environment. Managers choose packages of accounting policy, financial policy, and organizational structure (including performance evaluation and reward systems). Theoretical and empirical models have to be developed to sort out the endogeneity problems among the variables and, thereby, increase the power of the tests. While this is no easy task, it seems essential to significant advances in both the theories of the firm and of accounting.

Accounting numbers are used in different ways across industries. Besides the obvious regulatory uses of accounting numbers in financial institutions and public utilities, differences in industries' opportunity sets are likely to affect the accepted set of accounting methods. Two types of studies are likely to prove useful and again increase the tests' power. First, studies investigating differences in investment opportunity sets (e.g., the relative amount growth opportunities to assets in place, Myers 1977), accounting policies, organizational structures, and financial policies across industries are likely to produce information useful for the modelling suggested in the preceding paragraph. Second, intra-industry studies of accounting choice while requiring significant amounts of industry-specific knowledge by the researcher, have the potential of generating useful insights about the magnitude of contracting costs.

Third, measurement errors in net accruals can be reduced to increase the tests' power. This requires a model of net accruals not subject to managerial accounting discretion (Kaplan 1985; McNichols and Wilson 1988; DeAngelo 1988b; Moyer 1988). Also, replacing the simple indicator variables used to represent a bonus plan or an accounting-based debt covenant with continuous variables that better measure the relative magnitudes of various contracting costs will probably increase the theory's predictive power.

Conclusions

While the positive accounting literature has yielded empirical regularities and explanations for these regularities, it is clear there are many research opportunities available beyond those currently exploited. The tests of the debt, bonus, and political cost hypotheses represent very limited exploration. Incorporating both *ex ante* contracting efficiency incentives with *ex post* redistributive effects is likely to prove useful. Likewise, investigating the implications of internal contracts and external contracts other than debt and bonus contracts is likely to be productive. The major breakthroughs are likely to come from viewing accounting as a choice that is endogenous with the choice of organization, contracting, and financial structures. Such a breakthrough will be difficult to achieve, but important foundations can be laid by stressing the linkage between the theory and the empirical tests and by investigating inter- and intra-industry variations in accounting methods and other organizational choices.

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NOTES

Accounting Changes and Earnings Predictability

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ABSTRACT: Prior studies of the adoption of LIFO, SFAS No. 34, and APBO No. 18 document a significant positive association between security analysts' forecast errors and the current year earnings effect of changes in accounting method. Examination of a sample of largely unstudied and diverse accounting changes, using different sources of forecasts, allows evaluation of the pervasiveness and robustness of these earlier findings. Prior work is extended by considering a variety of voluntary and mandatory changes, the extent of prior disclosure of information regarding the change, the nature of forecast revisions during the year of the change, and by comparing the bias and dispersion of forecasts in change years to that in non-change years. Tests using a firm as its own control in a matched-pairs design control for industry and firm-specific factors. Consistent with prior work, the results of this study suggest that analysts do not fully revise their forecasts for the current year's earnings effect of changes in accounting method. A positive, but generally insignificant, association between forecast errors and the earnings effect of changes is reported. Both forecast errors and the dispersion of forecasts are greater in the year of an accounting change than in non-change years, particularly in the absence of prior information regarding the change. A significant negative association is reported between the revision in analysts' forecasts and the impact of an accounting change on income. This observed relation is consistent with managers adopting accounting changes with an income smoothing motivation.

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SEVERAL recent studies have examined the association between systematic errors in analysts' earnings forecasts and specific changes in accounting method as part of broader studies of specific changes in accounting method. Biddle and Ricks (1988) report that analysts systematically overestimated the earnings of 279 firms adopting LIFO in 1974. This overestimation produced analyst forecast errors that were positively associated with the current (change) year earnings effect of the accounting change. Moreover, the average magnitude of the forecast error was smaller if the change was disclosed prior to the earnings announcement date. Ricks and Hughes (1985) report systematic errors in analysts' forecasts of earnings for 75 firms that changed from the cost to the equity method of accounting for long-term investments as required by APBO No. 18. These forecast errors were also positively correlated with the current year earnings effect of the change. Similarly, Hughes and Ricks (1986) find a significant positive association between analysts' forecast errors and the impact on earnings of the adoption of SFAS No. 34, "Capitalization of Interest Costs."[1]

The findings of these studies suggest that analysts do not fully revise their forecasts for the current (change) year earnings effect of a change in accounting method. As noted by Hughes and Ricks (1986) this result could arise if analysts were unaware of the change, were unable to accurately predict the effects of the change or did not update their forecasts subsequent to estimating the earnings effects of the change.

This Note builds upon prior work by examining a large sample of more diverse accounting changes. Only 14 percent of the sample observations were included in the samples covered by the earlier work.[2] A variety of both voluntary and mandatory accounting changes are included and the effect of public disclosure of the change is examined directly. Specifically, prior work is extended by comparing the bias and dispersion of forecasts in accounting change years to that in non-change years for the same firms. By examining a large new sample of diverse accounting changes we evaluate the pervasiveness of the positive association between forecast errors and the earnings effect of the accounting change reported in earlier research. We also consider the association between analyst forecast revisions and the earnings effect of the change. Finally, by dichotomizing the sample on the level of prior disclosure regarding the change, we isolate cases in which analysts' failure to revise cannot be attributable to lack of knowledge or lack of opportunity to update their forecasts. This will help determine whether analysts forecast the effects of a known accounting change. The sample of 500 firms (612 separate changes) includes firms that made voluntary changes in accounting for inventories, depreciation, investment tax credit, pensions, and revenue and expense recognition and/or adopted SFAS Nos. 13, 34, 43, or 52.

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[1] Biddle and Ricks (1988), Hughes and Ricks (1986), and Ricks and Hughes (1985) all compute two different forecast errors. One based on actual reported earnings (i.e., (Actual Reported EPS − Forecast EPS)/Forecast EPS) and a second forecast error based on earnings "As If" the firm did not change accounting methods (i.e., ("As If" EPS − Forecast EPS)/Forecast EPS). In all three studies, the correlation between the current year income effect of the change in accounting method and analysts' forecast errors based on reported earnings is significantly positve. When "As If" forecast errors are used, the correlation with the effect of the change is negative.

[2] Our sample from the years 1976–1984 does not contain any of the 1974 LIFO adopters studied by Biddle and Ricks (1988) or the firms changing from cost to equity examined by Ricks and Hughes (1985). There is almost complete overlap of our sample with the SFAS No. 34 adopters in Hughes and Ricks (1986).

Section I describes the sample selection and data collection procedures and defines the variables of interest. Section II presents the research design, hypothesis development, and test results. The paper concludes with Section III.

I. Sample Selection and Data Collection

Identification of the Sample

The initial sample consisted of 1,273 firms with accounting changes sufficiently large to generate a consistency exception in the audit opinion. The sample was drawn from NAARS for the years 1976 to 1984.[3] Information regarding the impact of the accounting change, earnings forecasts, and actual earnings required to conduct statistical tests was available for 500 firms that made 612 accounting changes (see Table 1).[4]

The sample includes some individual changes with an immaterial effect on current operations. These changes were not excluded from the sample of 612 changes because they often occur in conjunction with a material change or in conjunction with several other immaterial changes, and the impact of the combined immaterial changes is material. Tests were repeated on the 90 percent of the sample firms reporting only material changes and no important differences were noted.

Table 2 reports the types of changes in accounting principle broken down by year. Table 3 documents the magnitude and sign of the income effects of these changes. The reported values are signed positively if the change increased income and negatively otherwise.

Table 2 shows that the changes are not distributed evenly over the nine-year period. This is particularly pronounced in 1981 when many firms adopted SFAS No. 43 (Accounting for Compensated Absences) and SFAS No. 52 (Foreign Currency Translation). Mandated changes in method constitute 53 percent of all changes in this study but the mix varies in individual years. In 1981 mandated changes constitute 77 percent of all changes, whereas in 1984 they represent only 12 percent.

Table 3 documents the magnitude and sign of the income effects of these changes. The reported values are signed positively if the change increased income and negatively otherwise. Although the majority of voluntary changes might be expected to increase current income, the opposite is true. This reflects the substantial number of changes to LIFO (40 percent or 116 of the voluntary changes) in the sample. The majority (67 percent) of the non-LIFO voluntary

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[3] In accordance with the NAARS procedure, years are defined to run from July 1 to June 30. For example, 1976 refers to fiscal years ending between July 1, 1976 and June 30, 1977.

[4] Annual reports or 10-Ks were used to determine: (1) primary EPS before extraordinary items, discontinued operations, and the cumulative effects of accounting changes, (2) the type of change(s) in accounting method, and (3) the impact of the change(s) on primary EPS. Forecasts of EPS are obtained from the Institutional Brokers Estimate System (I/B/E/S) developed by Lynch, Jones and Ryan.

Table 1
Sample Composition
(1976–1984)

Panel A. Characteristics of Firms Included in the Sample:	*Total*
Number of Firms with:	
Voluntary Changes Only	
1	198
2	12
3 or more	1
Total Voluntary	211
Mandatory Changes Only	
1	204
2	33
3 or more	1
Total Mandatory	238
Voluntary and Mandatory Changes	
2	41
3	7
4 or more	3
Total Combined	51
Total Included Firms	500
Panel B. Reasons for Excluding Firms:	
Excluded Firms:	
No Forecast Data Available	638
No Microfiche Available[a]	43
Other[b]	92
Total Excluded Companies	773
Total NAARS' Firms	1,273

[a] Information was gathered from the annual report.

[b] "Other" includes unreadable microfiche, coding errors by NAARS (i.e., incorrectly indexed as consistency exception), accounting changes complicated by changes in accounting year, and no disclosure in the annual report of the income effects of the change.

changes are income increasing. The predominant effect of the mandatory changes included in this period is to increase income (67.3 percent).

Classifications of Sample Data

Specific subsets of the data are considered in order to address whether the type of change (mandatory vs. voluntary), the extent of prior disclosure regarding the change, and/or the level of coverage by analysts affect the accuracy and

Table 2
Type of Change in Accounting Method by Year (1976–1984)

Type of Changes	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*Total*
Voluntary Changes										
FIFO to LIFO	9	5	22	26	34	12	4	2	2	116
Other to LIFO	1	1	4	4	2	2	1	0	1	16
Def. to FT-ITC[b]	0	0	5	4	2	2	5	0	2	20
Acc. to SL deprec.[c]	0	0	1	0	2	5	1	0	0	9
Other depreciation	1	1	1	0	3	1	6	5	3	21
Pension	1	0	0	0	1	1	1	4	2	11
Capitalize to Expense	0	0	2	1	2	2	0	0	0	7
Expense to Capitalize	1	0	3	3	2	4	2	1	0	17
Revenue Recognition	1	1	2	4	0	3	4	2	1	18
Miscellaneous Voluntary	1	5	6	7	8	7	6	8	4	52
Total Voluntary	15	13	46	49	56	39	30	22	15	285
Mandatory Changes										
SFAS No. 13—Leases	0	7	14	0	0	0	0	0	0	21
SFAS No. 34—Interest Capitalization	0	0	0	29	51	3	0	0	0	83
SFAS No. 43—Vacation Accruals	0	0	0	0	10	35	5	0	0	50
SFAS No. 52—Foreign Currency	0	0	0	0	0	94	40	9	0	143
Miscellaneous Mandatory	5	0	2	6	2	3	6	4	3	30
Total Mandatory	5	7	16	35	63	135	51	13	3	327
Total Changes[a]	20	20	62	84	119	174	81	35	17	612

[a] The total number of changes does not match the firm total in Table 1 due to multiple changes for some firms.

[b] Change from deferral to flow through method of accounting for investment tax credit.

[c] Change from accelerated to straight line method of depreciation.

Table 3
Income Effects of Changes in Accounting Method by Type of Change (1976–1984)

	Number of Firms	*Average EPS[a] Effect of the Change*		*Number (%) of Cases in Which Change Increase Income*	
		Mean	*Median*		
Voluntary Changes					
FIFO to LIFO	116	−0.0977	−0.0666	5	4.3%
Other to LIFO	16	−0.0795	−0.0832	2	12.5%
Def. to FT-ITC	20	0.1275	0.0596	18	90.0%
ACC. to SL deprec.	9	0.0509	0.0260	9	100.0%
Other depreciation	21	0.2216	0.0609	15	71.4%
Pension	11	0.1244	0.0761	8	72.7%
Capitalize to Expense	7	−0.0793	−0.0448	2	28.5%
Expense to Capitalize	17	0.1207	0.0442	12	70.6%
Revenue Recognition	18	0.0165	0.0238	11	61.1%
Miscellaneous Voluntary	52	0.0992	0.0479	35	67.3%
Total Voluntary	285	0.0098	−0.0234	118	41.0%
Mandatory Changes					
SFAS No. 13—Leases	21	−0.0018	0.0000	2	9.5%
SFAS No. 34—Interest Capitalization	83	0.1667	0.0579	79	95.2%
SFAS No. 43—Vacation Accruals	50	−0.0016	0.0000	4	8.0%
SFAS No. 52—Foreign Currency	143	0.4133[b]	0.0900	118	82.5%
Miscellaneous Mandatory	30	0.1795	0.0093	17	56.7%
Total Mandatory	327	0.2392	0.0404	220	67.3%
Total All Changes	612	0.1324	0.0155	337	55.0%

[a] Impact of change in accounting method on change year EPS divided by Annual Report EPS before the Accounting Change. A positive value indicates an increase in earnings.

[b] Three cases larger than three standard deviations from the mean account for the high mean value. With these omitted the mean is 0.1493.

dispersion of forecasts. First we consider how the mandatory versus voluntary distinction affects the analysts' ability to forecast the change. Voluntary changes are adopted at the discretion of management, while compliance with standards of the FASB is compulsory. In the absence of explicit disclosure of a change in accounting method, analysts must draw inferences about *both* the probability of a change and its income consequences. Probabilities of change are easier to predict for mandated changes than for voluntary changes since once the FASB adopts the standard, it is generally possible to identify firms that must comply. Uncertainty remains regarding both the timing and the income effects of mandated changes. Therefore, it is an empirical question whether analysts' forecast errors differ systematically for voluntary and mandatory changes.[5]

Since analysts' ability to forecast the earnings impact of a change is related to the level of disclosure, the sample was also differentiated according to the level of prior disclosure regarding the change. The existence of explicit prior disclosure identifies occurrence for voluntary changes and resolves uncertainty about the timing of mandatory changes.

The *Wall Street Journal Index* was reviewed to identify quarterly and annual earnings announcement dates and any separate mention of the accounting change. Since personal contact between analysts and companies may enable analysts to obtain superior knowledge of pending changes, this measure of prior information is imperfect.[6] In the sample of 500 companies, explicit prior disclosure occurs in 30 percent of the cases. The majority of these disclosures accompany a quarterly earnings announcement and do *not* indicate the magnitude or direction of the earnings effect.

The level of analyst coverage of a firm has been associated with the rapidity of response of prices to new information (e.g., Atiase 1985; Pincus 1985; Arbel 1985; Arbel and Strebel 1983). Therefore, the sample is segmented into low coverage firms (with four or fewer analysts reporting to I/B/E/S) and high coverage firms (five or more analysts).[7] If the probability that an analyst becomes aware of the change is increasing in the number of analysts that follow the company, forecasts are more likely to reflect the effects of accounting changes in the high coverage group. In addition, the separation of the high coverage group isolates firms with sufficient data to calculate dispersion statistics for testing hypotheses linking acounting changes to the dispersion of analysts' forecasts.

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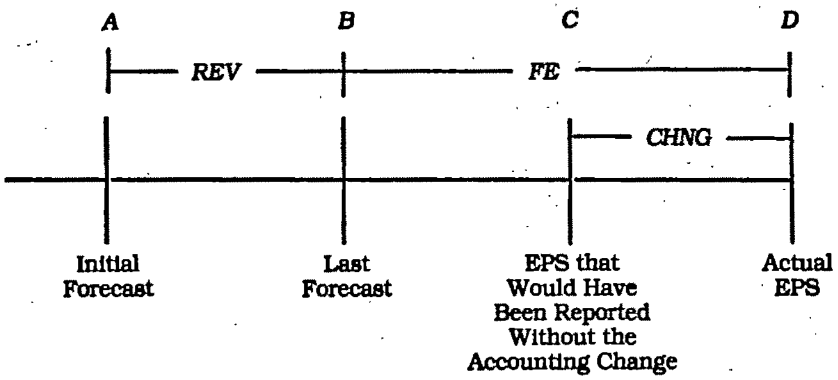
[5] We separately examined the change from FIFO to LIFO and the adoption of SFAS Nos. 34 and 52. These three changes are characterized by large sample sizes and large, consistently signed, income effects (see Table 3). No systematic differences between these cases and the separate results for voluntary and mandatory changes were found, thus details are not reported.

[6] Interviews conducted with analysts led us to conclude that refinement of this variable is impractical. Information sharing between analysts and firms is highly situation specific. The size of the company, the character, reputation and prestige of the analyst(s), and the context of the accounting change each affect the availability of such information. Some firms are likely to have been incorrectly classified as no disclosure firms in cases for which analysts knew of the change. This biases comparisons of forecast accuracy and dispersion between the prior and no prior disclosure groups against identifying systematic differences.

[7] While all analysts following a firm do not report to I/B/E/S, we expect a correlation between the number who do and the total number of analysts following the firm. The choice of five analysts as the cutoff is arbitrary. The separation of the sample based on number of analysts is also a proxy for a separation based on firm size. For the 284 firms in our sample included in the COMPUSTAT file, the Spearman correlation between the number of analysts and sales is .67.

Figure 1
An Example of the Relations Among Variables[a]


A
B
C
D
REV
FE
CHNG
Initial Forecast
Last Forecast
EPS that Would Have Been Reported Without the Accounting Change
Actual EPS

REV = Standardized Forecast Revision During Year $= (B-A)/|B|$
FE = Standardized Forecast Error $= (D-B)/|B|$
$CHNG$ = Standardized Effect of Accounting Change $= (D-C)/|B|$

[a] This figure illustrates a case where the initial forecast is low and is revised upward during a period when an income increasing change is instituted. All of the variables (*REV*, *FE*, and *CHNG*) are positive in this instance. Other combinations of variables would produce different relations and mixtures of positive and negative signs.

Variable Definitions and Data Sources

The variables used in this study are defined below.

Forecast Error:

$$FE = \frac{\text{Actual EPS} - \text{Last Forecast EPS}}{|\text{Last Forecast EPS}|}. \tag{1}$$

Forecast Revision:

$$REV = \frac{\text{Last Forecast EPS} - \text{Initial Forecast EPS}}{|\text{Last Forecast EPS}|}. \tag{2}$$

Effect of the Accounting Change:

$$CHNG = \frac{\text{Change Year Effect of Accounting Change on EPS}}{|\text{Last Forecast EPS}|}. \tag{3}$$

Actual EPS is before extraordinary items, discontinued operations and the cumulative effects of accounting changes as reported in the published annual report.[8] This reported EPS includes the current year effect of the change in accounting method.

Figure 1 illustrates one of many possible relations between forecast EPS, ac-

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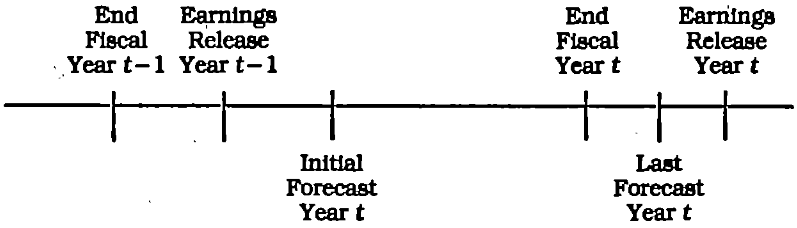
[8] In a January 1987 special feature in its *Monthly Comments*, I/B/E/S states "... the consensus of the analysts' expectations, as represented by the I/B/E/S mean, is usually based on the earnings before extraordinary items." The actual EPS number was selected to correspond to the definition of earnings in the forecast data.

Figure 2
Relative Timing of Earnings Releases and Related Earnings Forecasts


End Fiscal Year $t-1$
Earnings Release Year $t-1$
End Fiscal Year t
Earnings Release Year t
Initial Forecast Year t
Last Forecast Year t

Year t=Year of accounting change.

tual EPS, and the accounting change. Figure 2 presents a time line that illustrates the relative dating of the earnings' forecasts used in this study. The initial forecast for year t is the first I/B/E/S median EPS forecast for year t (the change year) made after revelation of actual earnings for the prior year ($t-1$). The last forecast for year t is the final I/B/E/S median forecast of EPS for year t preceding the announcement of year t earnings.[9]

To provide a natural interpretaion of *FE* as the percentage error in the forecast, we divide by the absolute value of the last forecast of EPS. The same scale factor is used in equations (2) and (3) for consistency. This gives *CHNG* an interpretation as the percentage impact of the change in accounting method on forecast EPS and *REV* is interpretable as the percentage revision. Use of forecast EPS as a deflator may lead to large values of the variables when the forecast is approximately zero.[10]

II. Research Design, Hypothesis Development, and Statistical Tests

Absolute Forecast Errors and Changes in Accounting Method

We initially examine the extent to which analysts' forecast errors are greater for annual earnings announcements that involve a change in accounting method. Both differential knowledge about the existence of the change and different beliefs about its consequences are consistent with larger forecast errors in the change year. The null hypothesis is:

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[9] The last median forecast may appear on the I/B/E/S tape during the month after the actual earnings have been released. Brown et al. (1985) report this for about 19 percent of the cases in their sample. These "late" forecasts are treated as timely because a number of institutional features suggest these forecasts were probably made prior to the earnings release but processing delays and the regularity of the I/B/E/S publication process lead to their late inclusion on the tape (see Brown et al. 1985, 25; O'Brien 1988).

[10] Using the same denominator for scaling *FE*, *REV*, and *CHNG* holds constant the effects of small absolute forecasts across the three measures. Approximately ten percent of our firms have absolute forecast EPS less than $1. The firms in that ten percent tend to be the same firms in both change and non-change years. Therefore, in tests that compare forecast error and forecast dispersion in the change and non-change years, the differences tend not to be extreme, even when the individual measures of error or dispersion are "extreme." More importantly, nonparametric tests based on ranks are used to mitigate the effect of extreme values. For similar approaches see Hagerman et al. (1984) and Hughes and Ricks (1987). Hughes and Ricks found their nonparametric results were robust to the choice of deflator when they deflated by both the forecast and by share price.

Hypothesis I: Analysts' forecast errors for firms with an accounting change are no larger than in a non-change year for the same firm.

Given the non-normality of the data reflected in a Kolmogorov-Smirnov test, this hypothesis is tested using a Wilcoxon matched-pairs signed-ranks test based on the following firm specific differences.[11]

$$FE_{DIFF,i} = |FE_{N,i}| - |FE_{\Delta,i}| \text{ for firm } i \tag{4}$$

where:

$|FE_{N,i}|$ = absolute value of forecast error in a non-change year.
$|FE_{\Delta,i}|$ = absolute value of forecast error in a change year.

The matched non-change year forecast error ($|FE_{N,i}|$) is from the closest prior or subsequent year in which there was no accounting change. When the prior and subsequent non-change years are equally distant from the change year, the matched year is chosen randomly. This procedure randomizes through time and controls for systematic changes over time in the earnings process and in forecasting technology. Using the same firm in a non-change year as the control accommodates industry specific and firm specific factors that may affect the size of *FE*.[12]

Table 4 reports the results of the Wilcoxon test for the whole sample and for subsets consisting of firms adopting a single mandatory change, a single voluntary change, and those with multiple changes, dichotomized by the presence or absence of prior information regarding the change. As reported in the first row of Table 4, the results for all firms are consistent with larger forecast errors in the year of an accounting change and are significant at $\alpha = .03$. Separating the sample on the presence of prior disclosure reveals no significant difference between the change and non-change year when prior disclosure exists (row 2, $\alpha = 0.77$) and significantly larger change year *FE*'s in the absence of prior disclosures (row 3, $\alpha = .01$). The remainder of Table 4 indicates that the significant year to year differences for all firms are attributable to the mandatory and multiple change subsets when no prior disclosure is evident. The insignificance of the test statistic for voluntary changes with no prior disclosure is somewhat surpris-

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[11] When the assumptions of the parametric *t*-test are met, the asymptotic efficiency of the Wilcoxon matched-pairs signed-ranks test compared with the *t*-test is 95.5 percent. The Wilcoxon test can be interpreted as a test of the null that the median difference between the absolute forecast error in the change and non-change years is zero (Conover 1971, 203 and subsequent). In testing Hypothesis I, actual earnings as reported by I/B/E/S were used due to the highly labor intensive effort of referencing annual reports to obtain actual earnings in non-change years. COMPUSTAT was not a feasible source of non-change year earnings since only 57 percent of our companies appear on COMPUSTAT. In general we have used earnings as reported in the annual report because we identified some coding errors in the I/B/E/S actual earnings. Replicating the majority of this study using I/B/E/S EPS produced essentially equivalent results to those reported using earnings from annual reports.

[12] Since many of the changes are concentrated by year (see Table 2), we cannot control for time/year specific phenomena. However, we conducted association tests between forecast errors, accounting change effects, and forecast revisions by year and found no significant yearly differences.

Table 4
Comparison of Change Year and Non-Change Year Absolute Forecast Errors (Change Years 1976–1984)

		Comparison of Change Year and Non-Change Year Absolute Forecast Errors		
	n	Percentage of Cases FE_{DIFF}[a] <0	One-Tailed Significance[b]	Median Absolute Effect of Accounting Change (|*CHNG*|)
All firms	498[d]	54	0.03	
Prior[c]	149	50	0.77	0.0861*
No Prior	349[d]	54	0.01	0.0666
Single Mandatory	203[e]	55	0.03	
Prior	51	47	0.75	0.0765*
No Prior	152[e]	57	0.02	0.0622
Single Voluntary	197[e]	52	0.16	
Prior	63	54	0.12	0.0920*
No Prior	134[e]	51	0.22	0.0666
Multiple/Mixed	98	51	0.09	
Prior	35	49	0.82	0.0780
No Prior	63	59	0.04	0.0860

$$|CHNG| = \left|\frac{\text{Effect of Change on Current Year EPS}}{\text{Last Forecast EPS}}\right|$$

[a] $FE_{DIFF,i} = |FE_{N,i}| - |FE_{\Delta,i}|$

where

FE = forecast error,
N = non-change year,
Δ = change year, and
i = firm i.

[b] Wilcoxon test of $FE_{DIFF} \neq 0$.

[c] Disclosure of the change in accounting method was made prior to the earnings announcement date.

[d] The sample size is decreased by two due to the unavailability of the non-change year forecast for matching purposes.

[e] The sample size is decreased by one due to the unavailability of the non-change year forecast for matching purposes.

* The difference between the no prior and prior median absolute *CHNG* is significant at the .05 level, using a Mann-Whitney test.

ing. Since LIFO adoptions comprise approximately 40 percent of the voluntary change subset and are often viewed as different in nature, we repeated this test on LIFO changes and voluntary, non-LIFO changes independently. Neither group exhibited significant test statistics.

If the income effect of accounting changes for firms without prior disclosure were systematically larger than for firms with prior disclosure, this would produce the results documented in Table 4. However, a disclosure policy motivated by corporate concern for full and fair disclosure, auditor pressure, or selective publication by financial editors would produce prior disclosure of the changes with the *largest* impact on reported earnings. As reported in the final column of Table 4, the median $|CHNG|$ is significantly larger ($\alpha \leq .05$) for firms with prior information in all but one subset of the data.[13]

Dispersion of Individual Forecast Errors

To the extent that accounting changes make it more difficult to forecast earnings, the individual forecasts of different analysts are expected to be more dispersed in years with accounting changes. The larger the change's impact, the larger the range of values analysts could forecast and the larger the standard deviation of the resulting forecasts.

The null hypothesis is:

> Hypothesis II: The dispersion of the forecasts of individual analysts for firm *i* in the year of an accounting change is equal to or less than the dispersion of forecasts for firm *i* in a non-change year.

The standard deviation of analysts' forecasts for year *t* is the standard deviation of the last consensus forecast reported by I/B/E/S immediately preceding the announcement of year *t* earnings. The coefficient of variation is calculated from that number as:

$$COEF=\frac{\text{Standard Deviation of EPS Forecasts}}{|\text{Mean EPS Forecast}|}. \tag{5}$$

In Table 5 the Wilcoxon matched-pairs signed-rank test is used to compare coefficients of variation in change and non-change years for the 305 cases for which five or more analysts provided forecasts. The dispersion of forecasts is significantly greater in the year of an accounting change for both mandatory and voluntary changes. This increased dispersion is generally greater in the absence of prior information than when explicit disclosure was made. The rejection of Hypothesis II is consistent with asymmetric information regarding the change, differing expectations about the effects of the change, or change years that are systematically more difficult to forecast for reasons unrelated to the accounting change. The likelihood of the final explanation is minimized since each calendar year represents a change year for some firms and a non-change year for other firms.[14]

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[13] Our prior disclosure dichotomy is based on explicit disclosure. As the compliance period for mandated accounting changes progresses, analysts will be better able to predict the income effects and timing of the change adoption for the remaining firms. As more firms announce compliance with a mandated standard, analysts become more familiar with how adoption affects earnings. Analysts also become more familiar with the characteristic differences between firms that do and do not adopt at the first opportunity. Both dimensions potentially affect predictive accuracy. We segmented the mandatory change firms into early adopters that comply prior to the final adoption date and late adopters that comply at the latest possible date. A Mann-Whitney test (not reported) showed no difference in the median forecast error of early versus late adopters.

[14] Since some event clustering occurs in the sample, the results for years 1981 and 1982 combined were examined separately from the remaining years. Each distinct group reflected a pattern of increased variation similar to the overall pattern, though statistical significance was lessened for the reduced sample sizes.

Table 5

Comparisons of Change Year and Non-Change Year Coefficients of Variation of Analysts' Forecasts for Firms Followed by Five or More Analysts (Change Years 1976–1984)

		Comparison of Change Year and Non-Change Year Coefficients of Variation		*Association of $\|CHNG\|$ with COEF*
	n	*Percentage of Cases $COEF_{DIFF}$[a] <0*	*One-Tailed Significance*[b]	$\hat{\rho}$
All firms	305	58	.01	
Prior[c]	102	55	.10	.37*
No Prior	203	59	.02	.23*
Single Mandatory	135	58	.05	
Prior	36	56	.10	−.05
No Prior	99	59	.09	.48*
Single Voluntary	108	56	.03	
Prior	41	61	.06	.39*
No Prior	67	55	.08	.16
Multiple/Mixed	62	60	.18	
Prior	25	44	.89	.27
No Prior	37	70	.08	.48*

$\hat{\rho}$ = Spearman correlation of *COEF* with $|CHNG|$

$$|CHNG| = \left| \frac{\text{Effect of Change on Current Year EPS}}{\text{Last Forecast EPS}} \right|$$

$$COEF = \frac{\text{Standard Deviation of Individual EPS Forecasts}}{|\text{Mean Forecast EPS}|}$$

[a] $COEF_{DIFF,i} = |COEF_{N,i}| - |COEF_{\Delta,i}|$

where:

$COEF_i$ is as defined above,
i = firm i,
N = non-change year, and
Δ = change year.

[b] Wilcoxon test of $COEF_{DIFF} \neq 0$.

[c] Disclosure of the change in accounting method was made prior to the earnings announcement date.

* Significant at $\alpha \leq .05$.

To the extent that the dispersion in forecasts is related to the accounting change, a cross-sectional association is expected between the income effects of the change and the dispersion of forecasts. The third null hypothesis is:

Hypothesis III: In the year of an accounting change there is no association between the absolute magnitude of the income effect of the change and the dispersion of analysts' forecasts.

This hypothesis is tested using Spearman correlations of the absolute magnitude of the income effect of the change ($|CHNG|$) with the coefficient of variation of the last consensus forecast. For the 305 sample firms with five or more analysts predicting earnings, the correlation is positive and significant ($\hat{\rho}=.316$, $\alpha<.0001$). As reported in Table 5, in two of the three independent categories (the single mandatory and mixed cases) the Spearman correlations are larger and more significant in the absence of prior information.

Bias in Forecast Error

The first three hypotheses concerned the dispersion of forecasts and the absolute size of forecast errors. Both could increase even though analysts were unbiased, on average, in their predictions of the effect of the accounting change. If analysts are unbiased in incorporating accounting changes, there should be no association between the signed forecast error and the signed accounting change. If (some) analysts do not anticipate the accounting change or do not adjust for it, a positive association between the forecast error and the accounting change is expected. A negative association would be consistent with (some) analysts overestimating the effect of the change. The null hypothesis is one of no association:

> Hypothesis IV: There is no cross-sectional association between the *signed* forecast error and the *signed* income effect of the accounting change.

Spearman correlations are used to evaluate the association of the signed effect of the accounting change with the signed forecast error.[15] The left-hand columns of Table 6 (Signed Forecast Error with Signed Accounting Change) provide results that are weakly consistent with prior research that finds a positive association for three specific changes. The results are significantly positive ($\alpha\leq.05$) for three of four gross subdivisions based on the number of analysts and the extent of prior information ($2\times2=4$; denoted "All"). Further partitioning by type of change in method yields 12 independent subcategories ($2\times2\times3=12$) with the four cells labeled "All" treated as summary categories and not included in the 12 subcategories. Nine of these 12 subsets reflect a positive correlation of forecast error with the income effects of the accounting change and three of these nine are significant at or above $\alpha=.04$. None of the negative correlations are statistically significant at conventional levels. This result is consistent with imperfect revision by analysts.[16] Within each prior study, the accounting changes under examination had consistent earnings consequences and occurred within close proximity in calendar time. Given the specific changes examined in these studies there may be commonality among sample firms as to size, industry membership, and/or production technologies. Such commonalities increase the likelihood of consistent forecast errors across firms. We have examined a diverse set of changes af-

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[15] The median forecast error for all 500 firms is small (.004) and insignificant ($\alpha=.461$). However, both the single mandatory and single voluntary subsets have median forecast errors that are of different sign (.022 and $-.012$) and significantly different at $\alpha=.02$. This is predominantly due to changes without prior information.

[16] Although not reported in the table, we combined firms with five or more analysts with firms with fewer than five analysts. The correlation of the signed accounting change with the signed forecast errors is positive for all subsets of the sample but insignificant in the majority of cases at $\alpha=.05$.

Table 6

Association of Signed Accounting Change with Signed Forecast Error and Signed Forecast Revision (1976–1984)

	Signed Forecast Error with Signed Accounting Change						*Signed Forecast Revision with Signed Accounting Change*					
	With Prior			*Without Prior*			*With Prior*			*Without Prior*		
	n	$\hat{\rho}$	*Two-Tailed Significance*	n	$\hat{\rho}$	*Two-Tailed Significance*	n	$\hat{\rho}$	*Two-Tailed Significance*	n	$\hat{\rho}$	*Two-Tailed Significance*
Panel A. Less Than or Equal To Four Analysts:												
All	47	.26	.03	148	.14	.05	47	−.17	.23	148	−.31	.00
Single Mandatory	15	−.07	.90	54	.05	.35	15	.08	.79	54	−.15	.29
Single Voluntary	22	.40	.03	68	.14	.12	22	−.27	.23	68	−.25	.04
Multiple/Mixed	10	.10	.39	26	.07	.37	10	−.05	.88	26	−.21	.29
Panel B. Greater Than or Equal To Five Analysts:												
All	102	.13	.10	203	.24	.00	102	−.30	.00	203	−.34	.00
Single Mandatory	36	.30	.04	99	.09	.19	36	−.11	.53	99	−.37	.00
Single Voluntary	41	−.17	.65	67	−.03	.89	41	−.24	.13	67	−.30	.00
Multiple/Mixed	25	.24	.12	37	.64	.00	25	−.28	.17	37	−.22	.18

$\hat{\rho}$ = Spearman Correlation Coefficient of *FE* with *CHNG* or *REV* with *CHNG*

$$FE = \frac{\text{Actual EPS} - \text{Last Forecast EPS}}{\text{Last Forecast EPS}}$$

$$CHNG = \frac{\text{Effect of Accounting Change on EPS}}{\text{Last Forecast EPS}}$$

$$REV = \frac{\text{Last Forecast EPS} - \text{Initial Forecast EPS}}{\text{Last Forecast EPS}}$$

fecting more diverse firms over a longer period of time, so weaker results are to be expected. The basic relation discussed here and in prior research suggests a positive association of forecast errors and accounting change effects arises because analysts fail to revise (or inadequately revise) their earnings predictions to capture the effect of accounting changes. As discussed below, this scenario has implications for forecast revisions during the year.

Revisions in Forecasts

To better understand the forecasting process and the year-end forecast errors, the association between the signed effect of the accounting change and the signed forecast revision during the year is examined.

The null hypothesis is:

> Hypothesis V: There is no cross-sectional association between the *signed* effect of the accounting change and the *signed* revision of analysts' forecasts during the year.

The hypothesis is two-sided. Our expectation for the association between forecast *revisions* (*REV*) and the effect of the change (*CHNG*) is conditional on the association between forecast *errors* (*FE*) and *CHNG*. Although the association between *FE* and *CHNG* is generally positive, the magnitude is weak. As a result, *ex ante*, we could not predict the relation between forecast revisions and the income effect of the change.

If analysts do not revise their forecasts for accounting changes, significant positive associations between *FE* and the *CHNG* arise but there would be no association between *CHNG* and *REV* made during the year. In other words, the forecast revision will *not* reflect the change effects. A significant positive association between *CHNG* and *REV* is expected if analysts revise forecasts to fully capture the effects of accounting changes, but in this case the correlation between *FE* and *CHNG* would be zero. Partial revision would result in a weaker positive association of the accounting change with both forecast error and forecast revision. Thus, expectations about the association of forecast revisions and the income effects of accounting changes are conditional on the association between forecast errors and accounting changes.

The right-hand columns of Table 6 (Signed Forecast Revision with Signed Accounting Change) present the Spearman correlations of signed accounting changes with signed forecast revisions. The positive but generally insignificant association reported earlier between the signed forecast error and the income effects of the accounting change implies imperfect adjustment and a weak but positive association between forecast revisions and the accounting change. Contrary to this expectation, Table 6 shows a negative association in 11 of the 12 independent subsets. In three of these cases (all without prior information), there is significantly negative association at $\alpha \leq .05$. The negative association of forecast revisions with the income effect of the change is consistent with a pattern of implementing accounting changes whose income effects are opposite to the trend in earnings.[17]

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[17] If quarterly accounting earnings are below (above) expectations or other unfavorable (favorable) firm specific information becomes available, then analysts will revise their forecast down (up). If firms

III. Discussion and Conclusions

This study examined analysts' forecasts in the presence of accounting changes. The problem facing the analysts, predicting the consequences of economic activity, is complicated by the additional difficulty of predicting the consequence of the accounting change. Absolute forecast errors and the dispersion of analysts' forecasts were found to be larger in the year of an accounting change than in a non-change year (Tables 4 and 5). Within the change year, the dispersion of forecasts among analysts following a given firm was correlated with the absolute value of the income effect of the change (Table 5). The relations were generally more significant in the absence of explicit disclosures about the change.

Some evidence of biased forecasts was present, conditional on type of change, sign of income effect of the change, and/or the extent of prior information. The bias in forecast errors was more significant in the absence of prior information. Consistent with previous studies, signed forecast errors were found to be positively correlated with the signed income effects of accounting changes (Table 6).

An expected positive association of forecast revision (*REV*) with the earnings effect of the accounting change (*CHNG*), conditional on unbiased forecasts, was not present. Rather, we found statistically significant *negative* associations between forecast errors and revisions (Table 6). This negative association was strongest in the absence of prior information. The observed negative relation is consistent with managers adopting accounting changes with an income smoothing motivation. Analysts may adjust their expectations to reflect the consequences of accounting changes but in this sample the effects of such revisions may be overpowered by revisions made in response to other economic factors affecting the firm.

In summary, the evidence presented is consistent with the view that earnings' forecasts are more dispersed and less accurate in a year with an accounting change. There tend to be significant biases in forecasts and positive associations between the magnitude of end-of-year forecast errors and the EPS effect of accounting changes. Negative associations between the accounting changes and the magnitude of forecast revisions during the year are suggestive of earnings management as a factor in accounting method choice.

Explicit prior disclosure was found in only 30 percent of the sample firms. Prior disclosure tends to be made by firms whose accounting changes have the largest impact on earnings. In spite of this, the median forecast error for firms with prior disclosure was less extreme than the forecast error of non-disclosing firms. This is consistent with an effort by analysts to incorporate the effects of *known* accounting changes and an effort by firms to inform the financial community of those changes with the most material impact.

Without knowing all of costs and benefits of more complete disclosure, the

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tend to make income increasing changes in "bad" years and income decreasing changes in "good" years, a negative association between forecast revisions and accounting changes would be observed. There is evidence in the existing literature that firms display this behavior (e.g., Ricks (1982) reports that firms adopt LIFO (an income decreasing change) in years when earnings are rising).

policy implications regarding the timing of disclosure of accounting changes are uncertain. However, the groups most affected by current practices include analysts, investors, and accounting researchers. To the extent that analysts and investors evaluate earnings announcements relative to existing forecasts that do not reflect accounting changes, inappropriate conclusions regarding the economic significance of forecast errors may be reached. Although an individual analyst will know the assumptions underlying her or his own forecast and, therefore, be able to correctly interpret her or his own forecast error, she or he may not be aware of the assumptions underlying the forecasts of other analysts. Similarly, investors will typically not know the assumptions underlying analysts' forecasts, making interpretation of the resulting forecast error more difficult.

Accounting researchers seeking to assess the link between security price changes and earnings disclosures may also be affected. The characteristics of forecasts demonstrated in this study suggest one source of noise in such studies. Worse, in years with a pattern of accounting changes of consistent sign, the forecasts may be biased. Existing disclosures by firms and by analysts are insufficient to allow the researcher to completely adjust for this phenomenon.

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The Market Interpretation of Management Earnings Forecasts as a Predictor of Subsequent Financial Analyst Forecast Revision

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ABSTRACT: This study investigates the relation between financial analyst earnings forecast revisions and two independent variables: (1) a measure of management earnings forecast news issued prior to analyst revisions, and (2) measures derived from the security market price reaction to that news. Results indicate that security price reactions to management forecasts are useful in predicting subsequent analyst forecast revisions. Furthermore, the explanatory power of price reaction is a function of the timing of the management forecast release.

RECENT studies (Beaver et al. 1980; Beaver et al. 1987; Collins et al. 1987) document that the accounting earnings and security price relation may be inverted so that security prices may be used to forecast earnings. Such a relation is possible if, for example, annual earnings releases convey information that the securities market receives earlier from other sources. In addition, Brown et al. (1985) document that security prices contain information related to analysts' earnings forecast errors and subsequent revisions. Recent results also support the information content of security price changes occurring at the dates of

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voluntary disclosures. For example, Jennings' (1987) results suggest that security price changes and subsequent analyst forecast revisions around the dates of voluntary management earnings forecasts are associated. McNichols (1989) documents an association of security price responses to management forecasts and subsequent earnings forecast errors derived from management forecasts and actual earnings.

This study examines the information in security price reactions to management forecast release conditioned by disclosure timing. Recent research finds timing to be a disclosure characteristic that affects the traditional unexpected earnings and unexpected price change relation, especially for bad news. Bathke and Lorek (1984) document positive abnormal returns for unexpected negative changes in earnings derived from time-series models and fourth quarter earnings releases. Mendenhall and Nichols (1988) also report a much weaker security price reaction to fourth quarter bad news, especially when measured relative to security analysts' forecasts.

Two sets of tests are performed. The first set, closely related to Jennings (1987), provides a starting point for analysis of the timing issue.[1] These tests examine whether security price changes reflect information about management earnings forecasts that explain financial analysts' subsequent earnings forecast revisions. This is possible if analysts observe and *use price changes* or *use the same information underlying price changes* to forecast earnings. This study does not distinguish between these alternative interpretations.[2]

The second set of tests examines whether the pricing implications of management forecasts vary with the timing of forecast disclosure. Specifically, tests examine whether analysts are less likely to condition their forecast revisions on *price changes* or on the *information underlying price changes* occurring later in the firm's reporting year. This result is suggested if components of the unexpected earnings in a management forecast are transitory in nature (and thus, not priced by the market) and if the likelihood that a management forecast conveys these components is greater in the fourth quarter. Alternatively, the tendency to delay bad news (Penman 1984, 1987; Chambers and Penman 1984; Kross and Schroeder 1984) and the early security price reflection of the news (McNichols 1989) may combine to produce this effect.

Basis for the Hypotheses

Analyst Revisions, Management Forecasts, and Security Prices

Hassell et al. (1988) document an association in terms of sign and magnitude between the news conveyed by management forecasts and subsequent compos ite analysts' revisions. This result is expected given the relative accuracy (Waymire 1986; Hassell and Jennings 1986) and informativeness (Patell 1976; Penman 1980) of management forecasts. However, this association between belief revisions due to management forecast releases and subsequent analyst forecast revisions may be attenuated or eliminated in certain cases. For example, managers may possess inferior information relative to other market participants or may not be truthful (Dye 1985; McNichols 1989).

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[1] Jennings (1987) does not construct tests of the information in security prices. However, based on the coefficient relations implied by reverse regression (Maddala 1977; Beaver et al. 1987), the results of a test in this paper using a continuous measure of security price change (described later) are derivable from his results. Also, in general, the association of security price changes and subsequent analyst revision is suggested by Jennings' results.

[2] If either interpretation holds, analysts act "as if" they use security price in forecasting earnings. Beaver et al. (1980, 26) identify the nature of this "as if" behavior as a link to "potential circularity" of analysts' forecasts.

Timing Hypothesis

Consistent with the Beaver et al. (1980) notions of permanent versus transitory components of earnings, Lipe (1986) argues that the persistence of earnings components affects security prices. It is possible that later forecasts by management may convey components of earnings expectations that are more transitory than earlier forecasts and, hence, that are priced to a lesser extent. Mendenhall and Nichols (1988) describe a reporting process whereby managers estimate accruals for interim reporting and have less discretion in disclosing annual results. Further, greater knowledge of transitory components is likely near year-end. For example, managers forecasting early in the year base their projections on expected (permanent) earnings adjusted for forecasted transitory components. Because transitory components are nonrecurring, they may be difficult to forecast. Thus, transitory components provide accurate adjustments to managers' earnings projections only as they are realized. Alternatively, discretionary manipulation of income may create transitory components. Healy (1985) provides a motivation for using fourth quarter discretionary adjustments to move annual earnings within a range of earnings subject to bonus. Finally, fourth quarter results may reflect corrections of errors during the first three quarters (Kinney and McDaniel 1989).

The tendency of managers to delay bad news (Penman 1984, 1987; Chambers and Penman 1984; Kross and Schroeder 1984) suggests a second possible timing effect. However, McNichols (1989) reports a significant association between news and price changes at the time of the forecast. Thus, while delaying bad news may weaken the power of security prices to explain analyst revisions, the effect probably is secondary in strength to the transitory component effect.

Hypotheses

Based upon the preceding arguments, three null hypotheses are tested:

H_{01}: Changes in earnings expectations based on management forecasts have zero or negative association with subsequent revisions of EPS forecasts by financial analysts.

H_{02}: Changes in earnings expectations implied by security price reactions to management forecasts have zero or negative association with subsequent revisions of EPS forecasts by financial analysts.

H_{03}: The information in security price changes pursuant to management forecasts is not affected by the timing of the forecast.

For H_{01} and H_{02}, the alternative hypotheses are positive association of management forecast news and security prices with analysts' revisions. For H_{03}, the information in security prices is expected to be reduced for late in the year forecasts.

Selection of Management and Analysts' Forecasts

Management forecasts are obtained from the Dow Jones News Retrieval Service database of articles appearing in *The Wall Street Journal* and *Barrons* for July 1, 1979 to December 31, 1982. Forecasts were included in the sample if they were attributed to a corporate official, were annual earnings per share point estimates (or convertible into point estimates by averaging range endpoints or dividing earnings by shares outstanding), and were issued prior to fiscal year-end. This search resulted in over 500 forecasts.

Analysts' forecasts are gathered from an archival tape of Zacks Investment Company's *Icarus Service*.[3] Seven weeks of analysts' forecast data were required for each firm, beginning with the week before the management forecast and ending six weeks after the forecast.

Management forecasts matched with the Zacks tape total 182.[4] Of these, 23 do not have sufficient security return data on the CRSP file to estimate unexpected security returns, and 12 others have insufficient data on the COMPUSTAT Annual Tape to estimate earnings volatility and certain other variables. Table 1 provides the distribution of the final sample of 147 management forecasts by year, by firm, by quarter of disclosure, and by exchange listing. The management forecasts are well distributed across firms and years. However, 44 percent of the forecasts (64 to 147) are issued in the fourth quarter.

Variable Measurement and Statistical Model

Dependent Variable—Analysts' Forecast Revisions

Defining the management forecast week as week zero, revisions in consensus analyst EPS forecasts are computed as follows:

$$AFR_{it}=(AF_{it}-AF_{i0})/SDEPS_{i} \text{ for } t=2, 4, 6 \tag{1}$$

where:

AFR_{it} = analysts' forecast revision for the firm issuing forecast i from week 0 through week t,
AF_{it} = consensus analysts' forecast in week t for firm i,[5] and
$SDEPS_{i}$ = the standard deviation of EPS for the firm issuing forecast i.

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[3] This tape contains weekly consensus analyst forecasts for about 2,400 companies.

[4] A detailed discussion of the search procedures is provided in Hassell and Jennings (1986, 61–65). This study's sample of 182 (up to this point) is greater than the Hassell and Jennings sample because it includes forecasts issued in the last month of the fiscal year. Since Zacks provides analysts' forecasts only up to the point at which actual earnings are available, the sample decreases for certain tests after the management forecast.

[5] The Zacks tape reports a mean (consensus) forecast for all analysts informing Zacks that they have made a forecast as of a given date.

Table 1
Distribution of Management Forecast Sample

By Year	*Number of Forecasts*
1979	32
1980	45
1981	37
1982	33
1979–1982	147

By Firm	*Number of Firms*	*Number of Forecasts*
Firms issuing one forecast	84	84
Firms issuing two forecasts	20	40
Firms issuing three forecasts	6	18
Firms issuing five forecasts	1	5
Totals	111	147

By Quarter of Disclosure	*Number of Forecasts*
First quarter	13
Second quarter	42
Third quarter	28
Fourth quarter	64
Total	147

By Exchange Listing	*Number of Forecasts*
Forecast issued by firm on NYSE	144
Forecast issued by firm on AMSE	3
Total	147

The calculation of analysts' forecast revisions uses windows of two, four, and six weeks for two reasons. First, little evidence exists on the rapidity of analyst adjustment to new information. Given that analysts manage the trade-off between timeliness and accuracy, a financial analyst may take some time to evaluate a management forecast, especially if it differs substantially from the analyst's forecast. Second, in some instances, an analyst's revision may precede a report to Zacks. The revisions are standardized by the standard deviation of the EPS stream for a number of years ending with the year preceding the forecast.[6]

[6] On average, 12.5 consecutive EPS numbers are used to estimate the standard deviation. Ninety-one percent of the standard deviations are estimated using between ten and 15 observations.

This relates revision magnitude to variability of earnings over time and, hence, controls for cross-sectional differences.[7]

Independent Variables

The two independent (information) variables are: (1) the change in earnings expectations conveyed by the management forecast for firm i ($CIEE_i$), which indicates the news in the management forecast; and (2) the unexpected security price change (CAR_i). $CIEE_i$ is measured by comparing the management forecast of EPS in week $t=0$ ($MF_{i,0}$) to the consensus analysts' forecast outstanding one week prior ($AF_{i,-1}$) and deflating by $SDEPS$:

$$CIEE_i=(MF_{i,0}-AF_{i,-1})/SDEPS_i. \tag{2}$$

To measure CAR_i, the market model is estimated via ordinary least squares regression over a 200-day period preceding the management forecast. CAR_i is the unexpected return for three days centered on the management forecast date, and accumulated and standardized using the method in Patell (1976).[8]

For one set of tests, categorical variable ($AGREE_i$) compares the signs of signals $CIEE_i$ and CAR_i. If the signs agree (disagree), then $AGREE_i=1$ ($AGREE_i=0$). As discussed in the next section, use of the $AGREE_i$ variable allows simple direct tests of the effects of signal disagreement on the relation between analysts' revision and management forecast news.

Table 2 provides descriptive statistics for the variables across all quarters and for late (fourth quarter) versus earlier quarters. Panel A reports negative means for analysts' forecast revisions (AFR_i) through weeks two, four, and six after management forecast release. The mean management forecast news ($CIEE_i$) is also negative. The security price reaction surrounding the forecast is nominally positive but insignificantly different from zero at a .05 level. Panel B reports that the signs of CAR_i and $CIEE_i$ agreed for 95 of 147 observations.[9]

Statistical Models—Overall Analysis

To test hypotheses H_{01} and H_{02}, two slightly different models relate security price changes and management forecast news to analysts' forecast revisions. The first examines the incremental information in security price changes holding management forecast news constant:

$$AFR_i=a_0+a_1(CIEE_i)+a_2(CAR_i)+e_i. \tag{3}$$

---

[7] Imhoff and Pare (1982) provide evidence that this deflator is a good surrogate for the standard deviation of forecasted amounts and performs as well as other potential earnings variability deflators.

[8] CAR_i is measured over three days while $CIEE_i$ is measured over approximately one week. However, a $CIEE_i$ measure for a shorter period could be obtained only by using a consensus analyst forecast from week zero. It is not possible to determine whether such a forecast was determined before or after the management forecast. Therefore, a week minus one forecast is used as a proxy for analysts' beliefs at the date of the management forecast and, thus, is consistent in terms of timing with a three-day CAR_i. All tests were repeated using a seven-day CAR_i ending the day after the management forecast. The results are generally consistent but weaker in some cases. This is expected since a seven-day CAR_i would average out the management forecast price reaction over a longer period and would probably contain price reactions to a number of other events.

[9] The tendency for $CIEE$ and CAR to agree in terms of sign is a general conclusion in the literature on management forecasts (Waymire 1984).

Table 2
Descriptive Statistics

Panel A. Continuous Variables:

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
AFR_2:[1]					
Quarters 1–3	82	−.032	.120	−.519	.300
Fourth Quarter	60	−.020	.147	−.800	.607
All Quarters	142	−.027	.131	−.800	.607
AFR_4:					
Quarters 1–3	82	−.047	.173	−.519	.599
Fourth Quarter	42	−.070	.168	−.800	.090
All Quarters	124	−.055	.171	−.800	.599
AFR_6:					
Quarters 1–3	82	−.068	.208	−.969	.674
Fourth Quarter	32	−.099	.198	−.854	.090
All Quarters	114	−.077	.205	−.969	.674
CIEE:					
Quarters 1–3	82	−.109	.430	−2.833	.777
Fourth Quarter	63	−.000	.333	−.876	1.438
All Quarters	145	−.062	.393	−2.833	1.438
CAR:					
Quarters 1–3	83	.122	1.659	−4.696	4.350
Fourth Quarter	64	.134	1.319	−4.622	3.752
All Quarters	147	.128	1.515	−4.696	4.350

Panel B. Categorical Variable:

Variable	Number of Observations	*AGREE* = 1	*AGREE* = 0
AGREE:			
Quarters 1–3	83	59	24
Fourth Quarter	64	36	28
All Quarters	147	95	52

[1] Definitions:

AFR_t = standardized composite revision in earnings per share estimate made by financial analysts from week zero to week *t* (week zero is the week of the forecast).

CIEE = change in earnings expectations calculated by comparing a management forecast to the preceding analyst forecast (standardized by the standard deviation of earnings per share).

CAR = standardized unexpected price reaction to the management forecast measured from the day before through the day after the forecast.

AGREE = indicator variable equal to one (zero) when the sign of changes in earnings expectations derived from a management earnings forecast agrees (disagrees) with the sign of the unexpected price reaction to the management forecast.

Under the H_{01} null, $a_1 = 0$. The expectation for a_1 is that it will be greater than zero. Under the H_{02} null, $a_2 = 0$. Again, the alternative is an expected positive a_2 coefficient.[10]

Equation (3), however, restricts a_1 across security price changes. To allow estimation of different associations of AFR_i and $CIEE_i$ as a function of security price changes, the categorical variable $AGREE_i$ is used in a second model:

$$AFR_i = b_0 + b_1(CIEE_i) + b_2(AGREE_i) + b_3(CIEE_i{*}AGREE_i) + e_i. \quad (4)$$

Testing for the difference from zero of slope coefficient b_1 and the sum of slope coefficients b_1 and b_3 examines the hypothesis of association between management forecast news and subsequent analyst revision (H_{01}), for the separate cases of $AGREE_i = 0$ and $AGREE_i = 1$. Under H_{02}, $b_2 = 0$ and $b_3 = 0$. If analysts' forecast revisions have a stronger association with management forecast news in the presence of signal agreement, then $b_3 > 0$.

Statistical Models—Timing Effect

To test the timing hypothesis, the coefficients in equations (3) and (4) are allowed to vary depending on whether the management forecast was issued in the fourth quarter. In equations (5) and (6), intercept and slope shift parameters are incorporated using an additional indicator variable, $FQTR_i$. For fourth quarter forecasts, $FQTR_i$ equals one (and zero otherwise):

$$\begin{aligned} AFR_i = {} & a_0 + a_1(CIEE_i) + a_2(CAR_i) + a_3(FQTR_i) + a_4(FQTR_i{*}CIEE_i) \\ & + a_5(FQTR_i{*}CAR_i) + e_i. \end{aligned} \quad (5)$$

$$\begin{aligned} AFR_i = {} & b_0 + b_1(CIEE_i) + b_2(AGREE_i) + b_3(CIEE_i{*}AGREE_i) \\ & + b_4(FQTR_i) + b_5(FQTR_i{*}CIEE_i) \\ & + b_6(FQTR_i{*}CIEE_i{*}AGREE_i) + e_i. \end{aligned} \quad (6)$$

In equation (5), the null hypothesis of no fourth quarter effect predicts that a_3 and a_5 equal zero. If transitory components of income included in fourth quarter management forecasts reduce the information in security price changes to predict subsequent analyst forecast revisions, then a_5 will be less than 0. If the fourth quarter effect is sufficiently strong such that fourth quarter security price changes contain no information, then $a_2 + a_5 = 0$. In equation (6), the null hypothesis of no fourth quarter effect predicts that b_4 and b_6 will equal zero. If transitory components in fourth quarter forecasts reduce the explanatory power of the $AGREE_i$ variable, then $b_6 < 0$ and $b_3 + b_6 = 0$.

While not a primary motivation of this study, an additional fourth quarter effect is captured by a_4 and b_5 in equations (5) and (6), respectively. If analysts either perceive that fourth quarter management forecasts are more accurate than earlier forecasts or base their revisions on more accurate information that they received during the fourth quarter, then a_4 and b_5 should be greater than zero.

Results

Table 3 presents results of the hypothesis tests before controlling for fourth quarter effects. The first column shows the three periods used to calculate ana-

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[10] This model is related to a model in Jennings (1987). Jennings finds a significant a_2 coefficient in a model with CAR_i as the dependent variable and a measure similar to AFR_i as the independent variable. Therefore, results of statistical tests using this equation provide a replication of certain of Jennings' results given the implications of reverse regression.

Table 3
Tests of the Association of Management Forecast News and Security Prices with Subsequent Forecast Revisions by Analysts (1979–1982) (Variables Described in Table 2)

Panel A. Model: $AFR_i = a_0 + a_1(CIEE_i) + a_2(CAR_i) + e_i$

Measurement Period for AFR_i	*Estimates (t-value in parentheses)* a_0	a_1	a_2	*Model F-statistic*	*Model*[1] R²
Week 0 to +2 (n=142)	−.020 (−2.02)*	.132 (5.23)**	.014 (2.12)*	17.24**	.198
Week 0 to +4 (n=124)	−.044 (−3.03)**	.145 (3.98)**	.025 (2.86)**	13.40**	.181
Week 0 to +6 (n=114)	−.056 (−3.22)**	.215 (5.06)**	.026 (2.48)*	17.46**	.239

Panel B. Model: $AFR_i = b_0 + b_1(CIEE_i) + b_2(AGREE_i) + b_3(CIEE_i^{*}AGREE_i) + e_i$

Measurement Period for AFR_i	b_0	b_1	b_2	b_3	b_0+b_2	b_1+b_3	*Model F-statistic*	*Model*[2] R²
Week 0 to +2 (n=142)	−.049 (−2.81)**	.089 (2.74)**	.045 (2.10)*	.106 (2.07)*	−.004 (−.33)	.195 (4.96)**	12.62**	.215
Week 0 to +4 (n=124)	−.081 (−3.21)**	.009 (.19)	.055 (1.81)	.314 (4.44)**	−.026 (−1.61)	.323 (6.19)**	13.47**	.251
Week 0 to +6 (n=114)	−.101 (−3.15)**	.079 (1.39)	.064 (1.68)	.311 (3.70)**	−.037 (−1.88)	.390 (6.31)**	14.87**	.288

[1] There is a significant increase in R^2 for this model over the R^2 from a model with only $CIEE_i$ as the independent variable. The hypothesis of equal explanatory value is rejected at the .05 level for the two-week AFR_i measurement period and at the .01 level for the two other measurement periods.

[2] The same as footnote 1 above except that the significance level for the six-week period is .01 rather than .05.

n=number of observations used in the regression.

* Significant at .05.

** Significant at .01. For the "Model *F*-statistic," this rejects the null hypothesis that all regression coefficients are zero.

lysts' forecast revisions (AFR_i). Panel A presents estimates for equation (3) using the continuous measure of security price reaction to the management forecast (CAR_i). The measurement period length for AFR_i does not affect the results. Significant positive coefficients on a_1 (at the .01 level for each AFR_i measurement period) indicate an association of management forecast news and subsequent analysts' revisions, thus rejecting H_{01}. Significant positive coefficients on a_2 (at the .01 level for the four-week revision period and at the .05 level for the other revision periods) indicate an incremental association of security price changes at the management forecast release and subsequent analyst revisions. These results allow rejection of H_{02}.

Panel B presents estimates of the alternative model (eq. [4]). Coefficient b_3 is always significantly positive. This indicates a stronger association of *AFR* and *CIEE* when security price signals agree in sign with the management forecast news. Coefficient b_1 is significantly different from zero for the two-week revision period only (.01 level). It is not clear why the earliest analysts' revisions would be associated with management forecast news when security prices disagree with the management forecast news (although the significant b_3 coefficient for the two-week AFR_i indicates that they are more strongly associated when prices agree). One possible explanation is that some analysts experience a lag between making a revision and assigning a date to that revision. As a result, the data base may include some revisions made before the management forecast date and the security price reaction.

Fourth Quarter Management Forecasts

Table 4 examines the primary hypothesis (H_{03}) that management forecast timing affects the relations documented in Table 3. In Panel A, coefficients a_3, a_4, and a_5 allow fourth quarter shifts in the relations. The intercept shift coefficient a_3 is not significantly different from zero for any AFR_i measurement period. The slope shift coefficient on $CIEE_i$ (a_4) is weakly significant for the two-week measurement period ($a_4=.096$, $p=.082$) and highly significant for the four-week and six-week measurement periods ($a_4=.337$ and .328, respectively; $p=.01$). These results suggest that analysts follow management news more closely in the fourth quarter. An explanation consistent with these results is the tendency for analysts to revise more after later in the year releases (Stickel 1989).[11]

Coefficient a_5 provides a measure of the fourth quarter effect on the association of CAR_i and analyst forecast revision. A negative estimate is expected if the information in security prices is less in the fourth quarter. For each AFR_i measurement period, coefficient a_5 is negative ($p=.05$ and .059 for the four-week and six-week measurement periods) and approximately equal in magnitude to the a_2

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[11] Stickel's results also may have implications for the weaker evidence obtained for the two-week AFR_i measurement period. As indicated in Table 2, the four-week and six-week *AFR* revision periods contain 42 and 32 fourth quarter forecast observations, respectively. Reducing the *AFR* measurement period to two weeks increases the sample by over 40 percent (42 to 60 observations). These additional observations are very close to year-end and, thus, approach the time when fourth quarter earnings releases occur. Stickel documents only a small amount of analyst revision activity in the ten days preceding interim earnings announcements.

Table 4

Tests for the Effects of Disclosure Timing on the Association of Management Forecast News and Security Prices with Subsequent Forecast Revisions by Analysts[1] (1979–1982)

Panel A. Model: $AFR_i = a_0 + a_1(CIEE_i) + a_2(CAR_i) + a_3(FQTR_i) + a_4(FQTR_i{*}CIEE_i) + a_5(FQTR_i{*}CAR_i) + e_i$

Measurement Period for AFR_i	Estimates (t-value in parentheses)						Model F-statistic	Model[2] R^2
	a_0	a_1	a_2	a_3	a_4	a_5		
Week 0 to +2 (n=142)	−.023 (−1.70)	.103 (3.38)**	.018 (2.32)*	.001 (.09)	.096 (1.75)	−.015 (−1.08)	7.70**	.220
Week 0 to +4 (n=124)	−.042 (−2.53)*	.085 (2.22)*	.033 (3.34)**	−.003 (−.10)	.337 (3.82)**	−.038 (−1.98)*	9.41**	.285
Week 0 to +6 (n=114)	−.055 (−2.77)**	.162 (3.59)**	.034 (2.95)**	−.001 (−.02)	.328 (3.02)**	−.045 (−1.91)†	9.84**	.313

Panel B. Model: $AFR_i = b_0 + b_1(CIEE_i) + b_2(AGREE_i) + b_3(CIEE_i{*}AGREE_i) + b_4(FQTR_i) + b_5(FQTR_i{*}CIEE_i) + b_6(FQTR_i{*}CIEE_i{*}AGREE_i) + e_i$

Measurement Period for AFR_i	b_0	b_1	b_2	b_3	b_4	b_5	b_6	Model F-statistic	Model[3] R^2
Week 0 to +2 (n=142)	−.058 (−2.82)**	.049 (1.27)	.051 (2.38)*	.136 (2.15)*	.006 (.31)	.149 (1.98)*	−.123 (−1.12)	7.03**	.238
Week 0 to +4 (n=124)	−.075 (−2.90)**	−.041 (−.90)	.049 (1.72)	.358 (4.76)**	.001 (.03)	.763 (4.71)**	−.742 (−3.92)**	11.61**	.373
Week 0 to +6 (n=114)	−.087 (−2.67)**	.037 (.67)	.048 (1.32)	.352 (3.91)**	.005 (.14)	.800 (3.82)**	−.800 (−3.34)**	10.78**	.377

[1] Variables described in Table 2 except for *FQTR* which is equal to one for fourth quarter forecasts and zero otherwise.

[2] For the four-week and six-week analyst revision periods, this model has more explanatory power than the Table 3 model. An *F*-test rejects the hypothesis of equal explanatory power at the .05 level.

[3] The same as footnote 1 above except that rejection occurs at the .10 level.

† Significant at .059.

* Significant at .05.

** Significant at .01.

coefficient on CAR_i. For the fourth quarter ($FQTR=1$), the following estimates are obtained:

$$
\begin{aligned}
AFR_i &= (a_0+a_3)+(a_1+a_4)CIEE_i+(a_2+a_5)CAR_i,\\
AFR_2 &= -.022+.199\ CIEE_i+.003\ CAR_i,\\
AFR_4 &= -.045+.422\ CIEE_i-.005\ CAR_i, \text{ and}\\
AFR_6 &= -.056+.490\ CIEE_i-.011\ CAR_i.
\end{aligned}
\tag{7}
$$

The coefficients on $CIEE_i$ in equation (7) are each significantly different from zero at the .01 level. The coefficients on CAR_i are not significantly different from zero at even the .10 level. Thus, security price changes pursuant to fourth quarter management forecasts do not provide incremental explanatory power for subsequent analyst forecast revisions. For earlier quarters ($FQTR=0$), coefficients a_1 and a_2 in panel A of Table 4 provide tests of the associations of $CIEE_i$ and CAR_i with AFR_i. As in the regression for all quarters in Table 3, the coefficients are significantly positive at $p \leq .05$.

The results in panel B of Table 4 lead to qualitative conclusions that are similar to those present in the panel A model, as well as some additional insights. First, recall that coefficient b_1 on $CIEE_i$ in Table 3 is significantly positive only for the two-week AFR_i period. This indicates analyst revision association with management forecast news in the presence of security price reactions whose signs do not agree with the management forecast's news. In Table 4, b_1 is only nominally positive (.049), indicating that the relation documented in Table 3 does not hold for the first three quarters. That is, signal disagreement eliminates significant association of analysts' forecast revisions and management forecast news. However, coefficient b_5 is significantly positive for each AFR_i measurement period indicating a strong fourth quarter effect on the association of analyst revision and management forecast news. Equally as strong in the opposite direction is coefficient b_6 (significant at the .01 level for the four-week and six-week AFR_i periods). This indicates that signal disagreement reduces the fourth quarter association of $CIEE_i$ and AFR_i.

For fourth quarter forecasts ($FQTR=1$) when signal agreement exists, the equations for each measurement period are:

$$
\begin{aligned}
AFR_i &= (b_0+b_2+b_4)+(b_1+b_3+b_5+b_6)CIEE,\\
AFR_2 &= -.001+.211\ CIEE,\\
AFR_4 &= -.025+.338\ CIEE, \text{ and}\\
AFR_6 &= -.034+.389\ CIEE.
\end{aligned}
\tag{8}
$$

These results are similar to those in Table 3 for all quarters. However, for fourth quarter forecasts and signal disagreement, the equations are:

$$
\begin{aligned}
AFR_i &= (b_0+b_4)+(b_1+b_5)CIEE,\\
AFR_2 &= -.052+.198\ CIEE,\\
AFR_4 &= -.074+.722\ CIEE, \text{ and}\\
AFR_6 &= -.082+.837\ CIEE,
\end{aligned}
\tag{9}
$$

These equations differ substantially from the signal disagreement case reported in Table 3 in that they imply significant analysts' revisions. Thus, the signal disagreement case ($AGREE=0$) appears to drive the fourth quarter (timing) effect.

Table 5
Binomial Test of Positive Association Between News Conveyed by Management Forecast and Sign of Unexpected Price Reaction (By Type of News, By Quarter) (1979–1982)

Null Hypothesis: There is no association between sign of management forecast news and sign of unexpected price reaction.

	Number of Forecasts	*Percentage of Unexpected Price Reactions That Agree*	*One-Tailed Binomial Test p-value*
Quarters 1–3			
Management Forecast Conveys Good News	33	.788	.001
Management Forecast Conveys Bad News	50	.660	.012
Quarter 4			
Management Forecast Conveys Good News	30	.667	.035
Management Forecast Conveys Bad News	34	.470	.242

Table 5 examines the nature of the *AGREE* variable by quarter and by type of management forecast news. If a positive sign relation exists between CAR_i and $CIEE_i$, then *AGREE* should equal one more than 50 percent of the time.[12] For quarters one through three, the signs of the management forecast news and unexpected price reactions agree 78.8 and 66.0 percent of the time for good and bad news, respectively ($p=.001$ and $p=.012$ for rejection of the null hypothesis that $p \leq .5$). For the fourth quarter, good news forecasts yield similar results. The percentage of signs in agreement equals 66.7 ($p=.035$). However, the null hypothesis is not rejected for bad news forecasts, as only 47 percent of the signs agree.[13] A possible explanation for the fourth quarter effect in panel B is that a high association of management forecast news and analysts' forecast revisions combines with a tendency for signal disagreement to occur in the fourth quarter (especially for bad news).

Additional Tests

Three additional tests were performed. The objective of the first is to provide direct evidence as to whether the transitory components of earnings hypothesis

[12] Research efforts by Waymire (1984) and Ajinkya and Gift (1984) document symmetric belief adjustment by the securities market to management forecast news. This is consistent with a positive sign relation between CAR_i and $CIEE_i$.

[13] Overall, the tendency for the disagreement case ($AGREE_i=0$) to prevail across all forecasts is positively associated with the fourth quarter.

explains the fourth quarter effect. The original 147 management forecasts are reviewed to determine if more statements about transitory items existed in the fourth quarter relative to earlier quarters. The incidence of *clearly* transitory items is low for several reasons. First, management forecasts that include extraordinary items are omitted from the original sample of 147 so that the sample would be comparable to Zacks' analysts' forecasts. Second, management usually does not cite *any reason* for a forecast. Third, reasons given for a management forecast may be highly contextual. For example, a manager citing increased industry demand as a basis for a more favorable forecast may not comment on whether the increased demand is likely to persist. Thus, expected persistence of a component of income may be industry, firm, or year specific. The implication of the second and third reasons for the hypothesis tests is that misclassification of a transitory item is likely.

Only 11 of the 147 forecasts are classified as conveying clearly transitory effects on income. Most of these relate to land transactions, securities transactions, or lawsuit settlements. Transitory items are included in eight of 64 fourth quarter forecasts and three of the 83 earlier forecasts. Although the number of transitory components is small, a chi-square test rejects the hypothesis of equal incidence of transitory items in favor of more fourth quarter transitory item disclosure ($p \leq .05$). Thus, with the clear limitation of classification error in mind, direct evidence supports the transitory component hypothesis. However, this test does not support the idea that transitory components underlie bad news forecasts more often in the fourth quarter. Of the eight fourth quarter forecasts with transitory components, four accompanied good news forecasts and four accompanied bad news forecasts.

A second issue relating to the results in Tables 3 and 4 concerns the presence of simultaneous information releases during the three-day period used to measure the sign of CAR_i. Waymire (1984) documents that simultaneous releases are associated as to sign with the news in management forecasts. Of the 147 management forecasts in Table 1, only 18 are issued with simultaneous disclosures of quarterly forecasts, quarterly earnings, or dividend changes. Moreover, only six of the unexpected components of these three types of disclosures have signs that disagree with the news in management's forecast.[14] Therefore, the likely impact of simultaneous disclosures on the measurement of signal agreement is small.

Finally, it is possible that other characteristics of the information environment are associated with the analyst revision process. For example, if analysts' revisions subsequent to a management forecast are merely a function of firm size and $AGREE_i$ is cross-sectionally associated with size, then the tests for slope shift would incorrectly indicate information in security prices. To assess the possibility that the $AGREE_i$ variable proxies for other characteristics, variables identified in prior research as characterizing some aspect of the information environment were included as independent variables in a logistic regression with $AGREE_i$ as the binary dependent variable. The variables selected were: (1) the value of common equity for the year-end preceding the management forecast to proxy for size; (2) the standard deviation of EPS to proxy for the precision of prior information; and (3) a dichotomous variable indicating whether the management forecast disclosure was made in the fourth quarter (*FQTR*).[15] The hypothesis that all parameter estimates in the logistic regression are zero is not rejected at a conventional significance level. In addition, a negative estimate for *FQTR* indicates a tendency for signal disagreement in the fourth quarter and for signal agreement earlier in the year.

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[14] Expectations for these disclosures are obtained from simple models described in Waymire (1984).

Concluding Remarks

The results of this study are consistent with a world in which analysts act as if they use security price reactions to management forecasts to revise beliefs about future earnings. This implies that analysts either use the information in security price changes or obtain this information from other sources. These results do not conflict with the existence of information in analysts' forecast revisions. The news conveyed by the management forecast and the agreement of the management forecast news and the unexpected price reaction to that news explains only a portion of analysts' forecast revisions. In fact, financial analysts may provide the additional service of translating security price information into information on future earnings prospects.

The results also indicate that disclosure timing affects the ability of management forecast news and security price changes to predict analysts' forecast revisions. While the association of forecast news and analysts' revisions is stronger in the fourth quarter, the association of security prices and analysts' revisions is eliminated. These results are consistent with the notion that fourth quarter management forecasts contain more earnings components with little or no pricing implications than forecasts issued earlier in the year.

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[15] The size measure is suggested by the work of Atiase (1985). Exchange listing is not included in the model (Grant 1980) due to lack of variation (see Table 1). The volatility measure is similar to the earnings predictability measure in Pincus (1983).

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The Effect of Informedness and Consensus on Price and Volume Behavior

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ABSTRACT: This paper presents a partially revealing rational expectations model of competitive trading to identify two effects of information releases; an informedness effect and a consensus effect. The informedness effect measures the extent to which agents become more knowledgeable, and the consensus effect measures the extent of agreement among agents at the time of an information release. We demonstrate that informedness and consensus generally occur jointly when information is disseminated, and that unexpected price changes and trading volume are *each* influenced by *both* informedness and consensus. Thus, interpretations of unexpected price changes and volume associated with information releases are conceptually similar. Since informedness and consensus each affect both the variance of price changes and volume, our paper provides an economic rationale for examining both price and volume effects at the time of information releases.

EMPIRICAL researchers have traditionally used unexpected price changes to measure the information content of public disclosures of information (e.g., Beaver 1968; Atiase 1985). An announcement is said to contain information if it alters investors' beliefs about the value of an asset (e.g., Beaver 1981, 117). Research in accounting indicates that the variance of unexpected price changes increases at the time of earnings announcements and that unexpected price changes are positively correlated with the unexpected component of earn-

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ings announcements. Researchers generally agree that unexpected price changes imply that an announcement contains information, that is, that it alters investors' beliefs.

In empirical studies, trading volume has also been used as a measure of information content with a number of researchers explicitly interpreting it as a measure of the extent of agreement or consensus among agents induced by the information.[1] The evidence clearly indicates that trading volume increases at the time of earnings announcements and that trading volume is positively correlated with the *absolute value* of the unexpected component of earnings announcements. Unlike price changes, researchers have been reluctant to draw strong inferences regarding the interpretation of volume reactions. For example, consider the discussion of Beaver's (1968) paper on observed volume at the time of earnings announcements contained in Watts and Zimmerman (1986, 64):

> While Beaver interprets an increase in the volume of trading as evidence of information, there is a problem with this interpretation. Conceptually, information could be conveyed to the market and prices could change by large amounts without a single transaction (trade).... On the other hand, there could be substantial trading (e.g., due solely to portfolio rearrangement) without any information release. The problem is the lack of an economic theory of volume. Consequently, as Beaver recognizes, his volume measure of information is *ad hoc*.

In this paper, we identify two effects of information: an informedness effect and a consensus effect. The informedness effect measures the degree to which agents become more knowledgeable, and the consensus effect measures the extent of agreement among agents at the time of an information release. We demonstrate that informedness and consensus effects generally occur jointly when information is disseminated, and that price changes and trading volume are *each* influenced by *both* informedness and consensus. Thus, interpretations of price changes and volume associated with information releases are conceptually similar. As such, the paper demonstrates that studies of unexpected price changes or volume are equally relevant means of assessing information "content" assuming that information content is defined as the extent to which an information signal alters investors' beliefs. Moreover, interpretations of volume as solely a measure of consensus appear incomplete since both informedness and consensus influence the behavior of volume and price.

With respect to price changes, we show that an increase in informedness results in an increase in the variance of price changes.[2] It is also the case that an increase in consensus results in an increase in the variance of price changes. Since information typically evidences simultaneous informedness and consensus effects, unexpected price changes are influenced by both phenomena. Consequently, whether the variance of unexpected price changes shifts upward or downward depends upon *both* the direction of the change in informedness and consensus (which determines whether the effects on the variance of price changes are reinforcing or countervailing), and which effect dominates in a particular informational setting if the effects are countervailing. Trading volume operates in a similar fashion to unexpected price changes. An increase in informedness results in an increase in trading volume, however, an increase in consensus results in a decrease in trading volume. Once again, trading volume is influenced by both informedness and consensus effects. Thus, trading volume may shift upward or downward depending upon whether shifts in informedness and consensus are reinforcing or countervailing, and if countervailing, which effect dominates.

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[1] Beaver (1968), Morse (1981), Bamber (1987), and Jain (1988) discuss volume as a measure of consensus. Verrecchia (1981) discusses the difficulties associated with interpreting volume reactions to information releases and concludes that no unambiguous inferences can be drawn about consensus when a volume reaction is observed.

[2] In this paper, unexpected change in price is examined, that is, how the realization of price deviates from its expectation. For convenience in exposition, we adopt the convention that the expressions "unexpected price changes" and "price changes" are equivalent.

To facilitate discussion, we introduce a partially revealing rational expectations model of competitive trading, in which many agents exchange a single risky asset and a single riskless asset over one period. At the start of the period, agents have homogeneous expectations with respect to the value of the risky asset. Exchange is motivated by agents receiving information about the liquidating value of the risky asset. Investors' interpretation of that information contains a noise term which is common across agents and an agent-specific idiosyncratic noise term. Information is modeled in this way to help assess the extent to which heterogeneous interpretations of a public information release result in price and volume reactions.[3] In this model, agents learn something about other investors' beliefs through the price aggregation process, but they do not learn everything. Hence, investors have heterogeneous expectations after the information is released.

A number of papers have examined the behavior of price changes or volume or both in a rational expectations context (e.g., Pfleiderer 1984; Varian 1985; Grundy and McNichols 1988; Holthausen and Verrecchia 1988; Kim and Verrecchia 1989).[4] One way to characterize broadly these papers is that they develop models that assume a variety of economic environments that lead to changes in price, trading volume, or both. Then, they consider how the various determinants of their models influence price changes and/or volume. The orientation of our work is somewhat different in that it concerns portraying and understanding informedness and consensus as primitive economic notions. How informedness and consensus affect unexpected price changes and volume is also shown and this links our work to what others have done. We are aware of no studies that provide a rigorous characterization of informedness and consensus, and their interrelation in a general economic setting.[5]

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[3] There is evidence in the accounting literature to suggest that accounting earnings are interpreted heterogeneously. What is relevant is not that each investor sees the same earnings per share figure, for example, but that investors reach varying conclusions about the revised value of the firm after an earnings announcement. Evidence in Morse et al. (1987) indicates that the variance of analysts' earnings forecasts for the subsequent year increases when the current year's earnings are announced. Moreover, this increased dispersion in analysts' forecasts is larger, the further announced earnings are from the consensus belief. This evidence is consistent with the notion that investors' assessments of the implications of earnings releases for the value of the firm are heterogeneous.

[4] These papers are based on the rational expectations paradigm. Other papers which assume different market processes include among others, Kyle (1985), Diamond and Verrecchia (1987), Karpoff (1986), and Admati and Pfleiderer (1988). See Karpoff (1987) for a review of theoretical and empirical work which explores the relation between volume and price changes.

[5] Our model only considers how information alters investors' beliefs and, in turn, how price and volume are affected. We abstract from trading which arises because of liquidity considerations, port-

This paper proceeds as follows. Section I describes a market process with many diversely informed agents, a single risky asset, and a single riskless asset over one period of trade. Further, we construct a partially revealing rational expectations equilibrium in this market where information is introduced, and trading arises, during the period. Section II defines measures of informedness and consensus and characterizes the variance of the unexpected change in price and trading volume in terms of informedness and consensus. We discuss how informedness and consensus affect the variance of the unexpected change in price and trading volume in Section III and concluding remarks are contained in Section IV.

I. Partially Revealing Rational Expectations Equilibria

Description of the Market

This section describes a partially revealing, rational expectations model of competitive trading. The model is intended to be as basic and generic as possible, specifically to capture those universal elements of the variety of rational expectations trading models that are variations on this theme.[6]

The market is comprised of a continuum of diversely informed and optimally motivated agents, each indexed by $a \in [0,1]$. At the beginning of the period, market participants are endowed with risky and riskless assets. The aggregate supply of risky assets is unknown, and uncertainty about the effect of its behavior on prices represents the noise in the economy. Within the period two events occur. First, each agent receives a signal about the liquidating value of the risky asset. Second, agents exchange assets on the basis of their information. This exchange of assets implies an equilibrium price p for the risky asset. When the period concludes, the risky and riskless assets are liquidated, and agents and traders consume their holdings of each.

The risky and riskless assets pay off in the economy's single consumption good. The risky asset is represented by the random variable $\tilde{u}$, which has a normal distribution with mean m and variance v. Realizations of $\tilde{u}$ are represented by u (i.e., the tilde is used to distinguish a random variable from its realization). The riskless asset is a numeraire commodity, one unit of which returns one unit of the single consumption good when assets are liquidated, independent of when the riskless asset is acquired (i.e., discounting is ignored).

Let the parameters D_a and B_a represent agent a's holdings of the risky and riskless assets, respectively, at the end of the period, where D_{0a} and B_{0a} are the agent's endowments of these assets. Each agent has a utility function for an amount w of the single consumption good characterized by $-\exp(-w/r)$. For this (negative) exponential utility function each agent exhibits constant absolute

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folio rebalancing, or tax effects. Admati and Pfleiderer (1988) develop a theory of strategic behavior on the part of liquidity traders and informed traders which is consistent with recent findings concerning patterns of volume and price variability within the day.

[6] Models very similar in spirit to the one here include, for example, those by Hellwig (1980), Verrecchia (1982), and Admati (1985).

risk-tolerance of r.[7] The objective of each agent is to maximize his or her expected utility of consumption when the market terminates at the end of the period: that is, $E_a[-\exp(-r^{-1}\{D_a\tilde{u}+B_a\})]$, where $E_a[\bullet]$ is agent a's expectation operator based on his or her information when he or she trades. An agent's ability to trade, however, is constrained by his or her endowment. That is:

$$D_a p + B_a = D_{0a} p + B_{0a}.$$

Information

At the beginning of the period, agents believe that $\tilde{u}$ has a normal distribution with mean m and variance v. The realization $\tilde{u}=u$ is the liquidating dividend of the risky asset and, thus, can be thought of as the risky asset's true, economic cash flow. The parameter v is the variance of that cash flow. During the period each agent receives an information signal and interprets what the information signal $\tilde{y}_a$ implies about the liquidating value $\tilde{u}$, such that each investor's interpretation of the signal is given by:

$$\tilde{y}_a = \tilde{u} + \tilde{\eta} + \tilde{\epsilon}_a,$$

where $\tilde{\eta}$ is a common noise term that has a normal distribution with mean zero and variance n, and $\tilde{\epsilon}_a$ is an idiosyncratic noise term that has a normal distribution with mean zero and variance s. The random variables $\tilde{u}$, $\tilde{\eta}$, and $\tilde{\epsilon}_a$ are each independent of one another. Furthermore, the idiosyncratic noise terms $\tilde{\epsilon}_a$ are independent across agents: that is, $E[\tilde{\epsilon}_a \bullet \tilde{\epsilon}_k]=0$ for all $a \neq k$.[8]

This particular form for the information release is chosen because we focus on the effects of heterogeneous interpretations of a public information release on prices and volume.[9] Evidence suggests that while investors all observe the same reported earnings, their interpretations of those earnings for the value of the firm are not homogeneous. In this environment, each agent observes the same public signal (e.g., an earnings announcement) but each agent's interpretation of what the signal implies about the value of the liquidating dividend varies because of the agent-specific noise term. With respect to an earnings announcement, this is akin to all agents observing the same reported earnings per share figure, and then determining the implication of the reported earnings for the value of the firm. What is relevant is not the earnings number *per se*, but the implications of the earnings release for the value of the firm. Moreover, the earnings signal *per se* does not contain a direct statement about the value of the firm which is known by all agents prior to their idiosyncratic assessment. As such, investors do not observe the common and idiosyncratic components of noise separately.

Definition of an Equilibrium

We suggest a model of the market process that operates in the following stylized fashion. Each period, agents submit demand orders to an auctioneer. The total per capita supply of risky assets is represented by $\tilde{z}$, where $\tilde{z}$ is independent of all other random events, and has mean z_0 and variance t. Therefore, when agents submit their demand orders to the auctioneer, they condition their beliefs on their individual signals, $\tilde{y}_a$, and price, $\tilde{p}$. Then, the auctioneer determines the market clearing price p such that agents' total per capita demand for the risky asset equals the realization of total per capita supply, z. Before defining an equilibrium, we add one more convention concerning the independent random variables $\tilde{\varepsilon}_a$. As the idiosyncratic noise terms are aggregated by price across a continuum of agents, they converge almost surely to their common mean of zero, provided their variance is uniformly bounded. The effect of this convention is that when prices aggregate information,

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[7] Without loss of generality, the results of this analysis are easily extended to the case in which agents have different levels of risk tolerance r_a.

[8] Indjejikian (1988), Lundholm (1988), and Pfleiderer (1984), among others, also model information with both a common and idiosyncratic component of noise.

[9] It is also appropriate to interpret the information signal as private information. However, because we are primarily interested in heterogeneous interpretations of a public information signal, the text does not explicitly recognize the private information interpretation.

$$\int_0^1 \tilde{y}_a da=\tilde{u}+\tilde{\eta}$$

almost surely.[10] A straightforward interpretation of this result is that as the number of agents becomes large, their idiosyncratic components of noise average to zero through the price aggregation process. This convention permits the following definition of an equilibrium.

Definition: An equilibrium with a continuum of agents is a price $\tilde{p}$ and an allocation function $D_a(\tilde{y}_a,\tilde{p})$, $B_a(\tilde{y}_a,\tilde{p})$, $a\in[0,1]$ such that:

(i) $\tilde{p}$ is $(\tilde{u}+\tilde{\eta},\tilde{z})$ measurable;
(ii) $(D_a(\tilde{y}_a,\tilde{p}),B_a(\tilde{y}_a,\tilde{p}))\in\arg\max \{D_ap+B_a=D_{0a}p+B_{0a}\}$
$E[-\exp(-r^{-1}(D_a\tilde{u}+B_a))|\tilde{y}_a,\tilde{p}]$; and
(iii) $\int_0^1 D_a(\tilde{y}_a,\tilde{p})da=z$ almost surely.

These statements jointly imply that price is a measurable function of the liquidating dividend of the risky asset plus noise and per capita supply, each agent maximizes his or her expected utility subject to his or her budget constraint, and markets clear (i.e., aggregate demand equals aggregate supply).

Characterization of an Equilibrium

When prices are of the form $\tilde{p}=\alpha+\beta(\tilde{u}+\tilde{\eta})-\gamma\tilde{z}$, the covariance matrix that describes the relation between $\tilde{u}$, $\tilde{y}_a$, and $\tilde{p}$ is given by:

$$\begin{array}{c} \tilde{u} \\ \tilde{y}_a \\ \tilde{p} \end{array} \begin{bmatrix} v & v & \beta v \\ v & v+n+s & \beta(v+n) \\ \beta v & \beta(v+n) & \beta^2(v+n)+\gamma^2 t \end{bmatrix}$$

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[10] We assume sufficient mathematical regularity to allow for this convention. For a more detailed discussion, see Hellwig (1980) or Admati (1985).

Therefore,

$$E[\tilde{u}|\tilde{y}_a=y_a,\tilde{p}=p]=m+(g,h)(y_a-m,p-E[\tilde{p}])'$$

and,

$$\Theta^{-1}=\mathrm{Var}[\tilde{u}|\tilde{y}_a=y_a,\tilde{p}=p]=v-(g,h)(v,\beta v)',$$

where the vector (g,h) is as defined by:

$$(g,h)=(v,\beta v)\begin{bmatrix} v+n+s & \beta(v+n) \\ \beta(v+n) & \beta^2(v+n)+\gamma^2 t \end{bmatrix}^{-1}.$$

This follows from standard formulae for determining a conditional expectation when $(\tilde{u},\tilde{y}_a,\tilde{p})$ have a tri-variate normal distribution. It is well-known that a feature of the (negative) exponential utility function is that agent a's demand is given by:

$$D_a=r\Theta(E[\tilde{u}|\tilde{y}_a=y_a,\tilde{p}=p]-p). \tag{1}$$

The market-clearing condition equilibrating demand with supply requires:

$$\int_0^1 D_a da=z \text{ almost surely.} \tag{2}$$

Thus, substituting in the expression for D_a given in equation (1) into equation (2), and rearranging terms, yields as the price for the risky asset:

$$p=(r\Theta[1-h])^{-1}(r\Theta m+\textstyle\int rg\Theta(y_a-m)da-rh\Theta E[\tilde{p}]-z). \tag{3}$$

But noting that the idiosyncratic terms ϵ_a disappear through the aggregation process (by convention), and the fact that $E[\tilde{p}]=m-(r\Theta)^{-1}z_0$ (which obtains by taking the expectation of both sides of eq. [1]) the expression for price simplifies to:

$$p=\alpha+\beta(u+\eta)-\gamma z,$$

where α, β, and γ are given by $\alpha=(1-\beta)m+(\gamma-\{r\Theta\}^{-1})z_0$, $\beta=g(1-h)^{-1}$, and $\gamma=(r\Theta\{1-h\})^{-1}$, respectively. For this representation of prices to be internally consistent (i.e., "rational"), (β/γ) must equal $r\Theta g$, which implies that it solves the equation $(\beta/\gamma)^3sn+(s+n)(\beta/\gamma)t-rt=0$. There exists a unique (β/γ) which solves this equation, and this solution constitutes the equilibrium. This characterization of an equilibrium is summarized in the following lemma.

Lemma 1: When prices are of the form:

$$\tilde{p}=\alpha+\beta(\tilde{u}+\tilde{\eta})-\gamma\tilde{z},$$

then α, β, and γ are defined by the relations:

$\alpha=(1-\beta)m+(\gamma-\{r\Theta\}^{-1})z_0$,
$\beta=g(1-h)^{-1}$, and
$\gamma=(r\Theta\{1-h\})^{-1}$,

where:

$$(g,h)=(v,\beta v)\begin{bmatrix} v+n+s & \beta(v+n) \\ \beta(v+n) & \beta^2(v+n)+\gamma^2 t \end{bmatrix}^{-1},$$

and:

$$\Theta^{-1}=\mathrm{Var}[\tilde{u}\,|\,y_a,p]=v-gv-h\beta v,$$

and the ratio of β to γ solves the equation:

$$(\beta/\gamma)^3 sn+(s+n)(\beta/\gamma)t-rt=0.$$

Proof: See the discussion above.

The straightforward representation of prices outlined in Lemma 1 is possible because the inherent linearity of the problem is preserved through the assumptions that prices are linear, random outcomes are normally distributed, agents have constant absolute risk tolerance, etc. In effect, price is the (appropriately weighted) sum of the aggregate information revealed during the period, $\tilde{u}+\tilde{\eta}$ (where the idiosyncratic noise terms $\tilde{\epsilon}_a$ average to zero since information is aggregated across agents), and random noise, $\tilde{z}$.

II. A Representation of Unexpected Price Changes and Volume

Measures of Informedness and Consensus

The ultimate objective in this section is to represent the variance of unexpected price changes and trading volume in terms of concepts of informedness and consensus (as well as other parameters of the model). But an intermediate step is to first introduce and define measures of informedness and consensus, and then (in Lemmas 2 and 5 below) show how they will be used.

To begin, note that agent a's expectation of end-of-period economic earnings, $\tilde{u}=u$, conditional on observing agent-specific information and price is:

$$E[\tilde{u}\,|\,\tilde{y}_a=y_a,\tilde{p}=p]=m+(g,h)(y_a-m,p-E[\tilde{p}])',$$

where (g,h) are defined in Lemma 1. Let the random variable $\tilde{x}_a$ represent agent a's *residual error* in his or her expectations and define it by:

$$\tilde{x}_a=\tilde{u}-m-(g,h)(\tilde{y}_a-m,\tilde{p}-E[\tilde{p}])'.$$

The variable $\tilde{x}_a$ can be thought of as an *unconditional*, or *ex ante*, measure of the difference between the realized outcome of economic earnings and agent a's *expectation* of that outcome conditional upon agent-specific information and price. For example, $\tilde{x}_a$ has a normal distribution with mean zero and second moment of:

$$E[\tilde{x}_a^2]=\mathrm{Var}[\tilde{u}\,|\,y_a,p]=v-(g,h)(v,\beta v)'.$$

The mean zero suggests that agents anticipate no difference between the realization of economic earnings and their expectations of that realization. The second moment around this difference is equal to the variance of economic earnings conditional on observing agent-specific information and price.

We define the *informedness* of each agent, and represent it by Θ, as $\Theta=(E[\tilde{x}_a^2])^{-1}$. This is identical to the definition of Θ used in Lemma 1. As such, agent a's level of informedness is characterized by the precision (i.e., the inverse of variance) of his or her beliefs conditional on observing the information and price. As Θ increases (decreases), agent a has more (less) precise information about the asset (holding everything else constant). To avoid limiting cases, we adopt the convention that Θ is positive and finite.

The consensus effect measures the extent of agreement across agents' beliefs. We define the *consensus* between agents j and k, and represent it by ρ, as:

$$\rho=\frac{E[\tilde{x}_j\tilde{x}_k]}{(E[\tilde{x}_j^2]E[\tilde{x}_k^2])^{1/2}}=\Theta E[\tilde{x}_j\tilde{x}_k].$$

In effect, the degree of consensus between two agents is governed by the covariance between their residual errors, i.e., $\tilde{x}_j$ and $\tilde{x}_k$. For example, as agents' information sources become more (less) common, the covariance between $\tilde{x}_j$ and $\tilde{x}_k$ increases (decreases). By construction, ρ is bounded between 0 and 1. To avoid limiting cases, we assume that ρ is positive and (strictly) less than one.

Characterization of Unexpected Price Changes in Terms of Informedness and Consensus

Let the random variable $\tilde{\Delta}$ represent the unexpected change in the price of the risky asset: that is $\tilde{\Delta}=\tilde{p}-E[\tilde{p}]$. Our concern is with the variance of $\tilde{\Delta}$ conditional on holding noise constant.

Lemma 2: The variance of the unexpected change in price, $\tilde{\Delta}$, conditional on the per capita supply of risky assets, is given by:

$$\text{Var}[\tilde{\Delta}|\tilde{z}=z]=v-\Theta^{-1}(2-\rho)-r^2(1-\rho)^2t^{-1}.$$

Proof: See the Appendix.

The price of the risky asset is an aggregator across agents' demands, beliefs, per capita supply, etc. As such, it also aggregates the exogenous noise in the economy. The rationale for holding constant the noise implicit in the uncertain per capita supply of risky assets, $\tilde{z}=z$, is to isolate that part of the variance of the unexpected change in price that is independent of noise. This allows a cleaner representation of the variance of the unexpected change in price which results from the release of information.

Characterization of Volume in Terms of Informedness and Consensus

In addition to prices, researchers commonly examine trading volume to assess the market's behavior. In particular, volume is thought to measure the extent of disagreement among market agents. Let the random variable $\tilde{\psi}$ represent the trading volume of informed agents. Variable $\tilde{\psi}$ is equal to one-half the absolute value of each agent's net demand aggregated across all agents. In the notation of our model, trading volume is defined by:

$$\tilde{\psi}=(1/2)\int_0^1|D_a(\tilde{y}_a,\tilde{p})-D_{0a}|da,$$

where $D_a(\tilde{y}_a,\tilde{p})-D_{0a}$ is the random variable that characterizes agent a's net demand. Agent a's net demand, $D_a(\tilde{y}_a,\tilde{p})-D_{0a}$, has a normal distribution with mean $\mu_a=z_0-D_{0a}$ and variance σ^2, which we calculate below in Lemma 5.

A volume statistic that parallels our treatment of the variance of the unexpected change in price is expected trading volume, $E[\tilde{\psi}]$. The variance of unexpected price changes at the time of information releases is used to characterize the effects of changes in informedness and consensus on unexpected price changes. Since price effects can be positive or negative, the variance is a more informative characterization for our purposes than, say, the mean. Trading volume results from the *absolute value* of net demand. Consequently, it is sufficient to understand how *expected* trading volume behaves when informedness and consensus shift, as opposed to, say, the variance or second moment of trading volume.

Some properties of the expected value of $\tilde{\psi}$ are outlined in the following two lemmas.

Lemma 3: Let $f(x;\mu_a,\sigma^2)$ and $F(x;\mu_a,\sigma^2)$ represent the density and cumulative density functions, respectively, of a normally distributed random variable with mean μ_a and variance σ^2 evaluated at x. Expected trading volume, $\tilde{\psi}$, is given by:

$$E[\tilde{\psi}]=\int\{\sigma^2 f(0;\mu_a,\sigma^2)-\mu_a F(0;\mu_a,\sigma^2)\}da,$$

where $\mu_a=z_0-D_{0a}$ is agent a's expected net demand, and σ^2 is the variance of his or her net demand.

Proof: It is a simple exercise to show that the expected absolute value of a random variable that has a normal distribution with mean μ and variance σ^2 is:

$$2[\sigma^2 f(0;\mu,\sigma^2)-\mu F(0;\mu,\sigma^2)]+\mu.$$

This implies, for the case of net demand, that:

$$E[|D_a(\tilde{y}_a,\tilde{p})-D_{0a}|]=2[\sigma^2 f(0;\mu_a,\sigma^2)-\mu_a F(0;\mu_a,\sigma^2)]+\mu_a.$$

Recalling that $\int\mu_a da=0$ since per capita supply of the risky asset must equal per capita endowment, aggregating the above over all agents yields the expression for $E[\tilde{\psi}]$ given above. Q.E.D.

Note that expected trading volume is an increasing function of the standard deviation of agents' net demand, σ. Consequently, to understand how information affects volume, it is sufficient to examine the behavior of σ^2, since changes in σ^2 imply an identical change in expected trading volume. Thus, the following lemma.

Lemma 4: Expected trading volume is an increasing function of the standard deviation (and similarly the variance) of agents' net demand.

Proof: From the proof to Lemma 3, the expected absolute value of a random variable that has a normal distribution with mean μ and variance σ^2 is:

$$2[\sigma^2 f(0;\mu,\sigma^2)-\mu F(0;\mu,\sigma^2)]+\mu.$$

Differentiating this expression with respect to σ yields:

$$[\sigma+(\mu^2/\sigma)]f(0;\mu,\sigma^2)-(\mu/\sigma^3)\int_{-\infty}^{0}[(x-\mu)^2-\sigma^2]f(x;\mu,\sigma^2)dx.$$

Note, however, that the last expression integrates to:

$$-(\mu^2-x\mu/\sigma)f(x;\mu,\sigma^2)\Big|_{-\infty}^{0}=-(\mu^2/\sigma)f(0;\mu,\sigma^2).$$

Substituting into the above yields:

$$[\sigma+(\mu^2/\sigma)-(\mu^2/\sigma)]f(0;\mu,\sigma^2)=\sigma f(0;\mu,\sigma^2)>0.$$

This implies that the expected absolute value of the net demand of each agent is an increasing function of σ. Thus, expected trading volume (i.e., the expected net demand integrated across all agents) is also an increasing function. Q.E.D.

By virtue of Lemma 4, it is sufficient to examine the behavior of the standard deviation of agents' net demand and, thereby, ignore both prior beliefs and endowments in understanding the effects of informedness and consensus on expected trading volume.[11] Therefore, it only remains to represent the variance of agents' net demand in terms of informedness and consensus as in our final lemma.

Lemma 5: The variance of agents' net demand is given by:

$$\sigma^2=r^2\Theta(1-\rho)+v.$$

Proof: See the Appendix.

In summary, the expression for the variance of the unexpected change in price, given in Lemma 2, and the expression for the variance of agents' net demand, represented in Lemma 5, will form the basis for determining the effects of informedness and consensus on price changes and volume.[12]

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[11] It should be emphasized that it is sufficient to examine the behavior of σ^2 provided that agents are comparably informed (i.e., the variance of their idiosyncratic noise terms, ϵ_a, is identical for all agents). When agents are not comparably informed, it is still the case that each agent's expected net demand is a monotonic function of the standard deviation of his net demand. However, it is not necessarily the case that the standard deviation of all agents' net demands move in the same direction (i.e., for some agents their σ^2's might fall, whereas for some other agents their σ^2's might increase). Since the σ^2's are not moving in parallel, expected trading volume (i.e., the expected net demand integrated across all agents) is not necessarily moving in one direction versus another.

[12] Note that we controlled for noise (by conditioning over it) in computing the variance of the change in price, but found this unnecessary when dealing with the variance of net demand. This difference in approach arises because price aggregates across all features of the economy and, thereby, is influenced significantly by noise. In contrast, an *individual agent's* net demand, while affected by noise, is not affected as directly. Consequently, the device of demonstrating a monotonic relation between the variance of net demand and expected trading volume (i.e., Lemmas 3 and 4) makes conditioning over noise unnecessary.

III. The Influence of Informedness and Consensus on Price Changes and Volume

To demonstrate that both informedness and consensus influence the variance of unexpected price changes, consider the effect of each holding the other constant. To elaborate briefly on this issue, imagine that all the exogenous parameters in the model are held fixed *except* n and s. Then an increase in informedness, holding consensus constant, is tantamount to n and s shifting such that agents' informedness increases while consensus between agents remains fixed. Similarly, an increase in consensus holding informedness constant is tantamount to n and s shifting such that agents' consensus increases while their informedness stays fixed.[13]

Using the definitions of informedness and consensus outlined in the previous section, we offer the following results.

Proposition 1: As agents' informedness about the risky asset increases holding the consensus among them constant, the variance of the unexpected change in price increases: that is, as Θ increases holding ρ fixed, $\operatorname{Var}[\tilde{\Delta}|\bullet]$ increases.

Proof: From Lemma 2,

$$\frac{d\operatorname{Var}[\tilde{\Delta}|\bullet]}{d\Theta}=\Theta^{-2}(2-\rho)>0,$$

since (by convention) $\Theta>0$ and $\rho<1$. Q.E.D.

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[13] In the former case, the way to determine explicitly how n and s shift is to propose the following two simultaneous equations,

$$\frac{d\Theta}{d\Theta}=1 \quad\text{and}\quad \frac{d\rho}{d\Theta}=0,$$

using expressions for Θ and ρ offered in the Appendix, and then solve for:

$$\frac{dn}{d\Theta} \quad\text{and}\quad \frac{ds}{d\Theta}$$

as two unknowns. In the latter case,

$$\frac{dn}{d\rho} \quad\text{and}\quad \frac{ds}{d\rho}$$

are solved for as two unknowns in the two simultaneous equations:

$$\frac{d\Theta}{d\rho}=0 \quad\text{and}\quad \frac{d\rho}{d\rho}=1,$$

once again using definitions of Θ and ρ. Because the number of unknowns equals the number of (simultaneous) equations, the solutions to:

$$\frac{dn}{d\Theta},\ \frac{ds}{d\Theta},\ \frac{dn}{d\rho},\ \text{and}\ \frac{ds}{d\rho},$$

are unique and well defined. Therefore, with no loss of generality, we assume that n and s shift appropriately to ensure increases in informedness holding consensus constant, and vice versa, without explicitly detailing these solutions. Of course, there is no reason to require that the other exogenous parameters, e.g., v, r, t, remain fixed. The only problem here is that there are more unknowns than (simultaneous) equations and, thus, these relations are not unique. Our point is that one need not restrict changes in informedness and consensus to changes in n and s alone.

Essentially, Proposition 1 states that as the informedness about the risky asset increases, the realization of price is likely to be farther from its expectation. This is because, given a fixed set of beliefs, agents' demands increase as they become more knowledgeable. Consequently, this increased demand pushes prices further away from their expected value.

The next result concerns the consensus effect.

Proposition 2: As the consensus among agents about the risky asset increases holding their informedness constant, the variance of the unexpected change in price increases: that is, as ρ increases holding Θ fixed, $\mathrm{Var}[\tilde{\Delta} | \bullet]$ increases.

Proof: From Lemma 2,

$$\frac{d\,\mathrm{Var}[\tilde{\Delta} | \bullet]}{d\rho} = \Theta^{-1} + 2r^2(1-\rho)t^{-1} > 0,$$

since (by convention) $\Theta > 0$ and $\rho < 1$. Q.E.D.

Essentially, Proposition 2 establishes that as the consensus across agents' beliefs increases due to a change in the mix of common and idiosyncratic components of information, the more variable is price (and, hence, unexpected price changes). This is because as agents' residual errors become more correlated, there is less uncertainty resolved through the market aggregation process. Thus, price at the end of the period is more variable because of this decreased resolution of uncertainty.

The results involving volume are equivalent to those involving unexpected price changes, except for the fact that trading volume *decreases* as consensus increases holding informedness constant. The reason trading volume increases as informedness shifts upward is that, *ceteris paribus*, agents' demands become more extreme as agents become more knowledgeable. Consequently, trading volume will increase. The reason trading volume decreases as consensus shifts upward is that, *ceteris paribus*, increased consensus implies less diversity of opinion among agents. Consequently, trading volume will decline. This intuition is formalized below.

Proposition 3: As agents' informedness about the risky asset increases holding the consensus among them constant, expected trading volume increases: that is, as Θ increases holding ρ fixed, $E[\tilde{\psi}]$ increases.

Proof: From Lemmas 3 and 4, it is sufficient to examine the behavior of the variance of net demand. But from the definition of the variance,

$$\frac{d\sigma^2}{d\Theta} = r^2(1-\rho) > 0,$$

since by convention $\rho < 1$. Q.E.D.

Proposition 4: As the consensus among agents about the risky asset increases holding their informedness constant, expected trading volume decreases: that is, as ρ increases holding Θ fixed, $E[\tilde{\psi}]$ decreases.

Proof: Using the definition of the variance of net demand,

$$\frac{d\sigma^2}{d\rho} = -r^2\Theta < 0,$$

since by convention $\Theta > 0$. Q.E.D.

The Simultaneous Influence of Information on Informedness and Consensus

It is important to emphasize that when information is disseminated or acquired, the variances of the common and idiosyncratic components of agents' information affect the level of informedness and the degree of consensus simultaneously. For example, consider an increase in the variance of the common component, n. As the variance of n increases, informedness tends to be reduced because the greater noise in agents' information makes them less knowledgeable. Simultaneously, increased n is likely to increase the consensus across agents because their signals are more conditionally dependent. Thus, a shift in n affects both informedness and consensus. Since an increase in n works to decrease informedness and increase consensus, the effect of increased n on the variance of unexpected price changes is ambiguous, whereas it is likely to decrease trading volume unambiguously.

Similar effects are observed for a shift in the variance of the idiosyncratic component, s. As the variance of s increases, informedness is likely to be reduced because of the greater noise in agents' information, and consensus is likely to be decreased because agents' signals are less conditionally dependent. An increase in s works to decrease informedness and decrease consensus, which is likely to lead to an unambiguous decline in the variance of unexpected price changes, whereas the effect on trading volume is ambiguous. Except for very special cases, simultaneous shifts in the variances of n and s result in similar concurrent shifts in informedness and consensus.

Thus, information releases simultaneously affect both price changes and trading volume through informedness and consensus. It would be rare to observe an informedness effect absent a consensus effect, or a consensus effect absent an informedness effect. Since price changes and volume are both affected by simultaneous changes in informedness and consensus at the time of an information release, interpretations of price changes or volume are conceptually similar.

IV. Conclusion

The major results of this paper are as follows. First, we suggest that information manifests both informedness and consensus effects simultaneously. Second, we show that informedness and consensus each affect both the variance of unexpected price changes and trading volume. Hence, interpretations of the variance of price changes and interpretations of volume reactions are conceptually similar. Thus, both price and volume studies are equally relevant means of assessing the information content of an earnings announcement. Third, we indicate exactly how changes in informedness and changes in consensus affect the variance of unexpected price changes and trading volume. More specifically, we show that an increase in informedness results in an increase in the variance of unexpected price changes and an increase in trading volume. An increase in consensus results in an increase in the variance of price changes and a decrease in trading volume.

Our model helps to interpret existing empirical evidence. Consider, for example, the effect of an earnings announcement on price changes and trading volume. The empirical literature indicates that both the variance of price changes and trading volume increase at the time of an earnings announcement (see, e.g., Beaver 1968). If one defines information content as the ability of an information signal to alter investors' beliefs, evidence on volume reactions is as relevant for assessing information content as evidence on unexpected price changes. Thus, the reluctance of some authors to interpret volume reactions as evidence of information content seems unfounded.

While empiricists have not generally studied the extent to which price changes and volume represent shifts in informedness and consensus, we suggest that by considering price changes and volume in combination, empiricists could learn something about the relative amounts of informedness and consensus. The discussion of informedness and consensus implies that the variance of price changes and trading volume tend to be positively related when the informedness effect dominates the consensus effect, and tend to be negatively related when the consensus effect dominates the informedness effect.

Since informedness and consensus each affect both the variance of price changes and volume, we provide an economic rationale for examining both price and volume effects at the time of information releases. Moreover, viewed within the framework of the model, it is not a surprise that the empirical literature has documented an increase in the variance of price changes and an increase in trading volume at the time of information releases (such as accounting earnings announcements): both of those findings are consistent with accounting earnings containing information.

Appendix

Proof of Lemma 2

The change in price is defined by:

$$\tilde{\Delta}=\tilde{p}-E[\tilde{p}]=\alpha+\beta(\tilde{u}+\tilde{\eta})-\gamma\tilde{z}-E[\tilde{p}].$$

It is a straightforward exercise to show that the variance of $\tilde{\Delta}$ conditional on $\tilde{z}=z$ is:

$$\mathrm{Var}[\tilde{\Delta}|\tilde{z}=z]=\beta^2(v+n). \tag{A1}$$

The majority of the work involves representing β and n in terms of informedness and consensus to complete the expression. In the case of β, note that by definition $\Theta^{-1}=v-gv-\beta hv$, and (using the expressions for β and γ in Lemma 1) $g=(\beta/r\Theta\gamma)$ and $h=1-(r\Theta\gamma)^{-1}$. These expressions imply:

$$\begin{aligned}\Theta^{-1}&=v-gv-\beta hv,\\ &=v-(\beta v/r\Theta\gamma)-\beta v(1-[r\Theta\gamma]^{-1}),\text{ and}\\ &=v-\beta v.\end{aligned} \tag{A2}$$

Manipulating equation (A2) yields:

$$\beta=1-(\upsilon\Theta)^{-1}. \tag{A3}$$

Representing n is considerably more difficult. First, note that by definition,

$$\begin{aligned}\rho&=\Theta E[\tilde{x}_j\tilde{x}_k]\\&=\Theta(1,g,h)\begin{bmatrix}\upsilon & -\upsilon & -\beta\upsilon\\ -\upsilon & \upsilon+n & \beta(\upsilon+n)\\ -\beta\upsilon & \beta(\upsilon+n) & \beta^2(\upsilon+n)+\gamma^2 t\end{bmatrix}(1,g,h)'\end{aligned} \tag{A4}$$

If, into equation (A4), one substitutes the following expressions for Θ, g, and h (which are implied by the equilibrium outlined in Lemma 1):

$$\Theta^{-1}=\frac{\upsilon(s[n\{\beta/\gamma\}^2+t]+nt)}{s([\upsilon+n][\beta/\gamma]^2+t)+(\upsilon+n)t},$$

$$h=\frac{\upsilon s(\beta/\gamma)\gamma^{-1}}{s([\upsilon+n][\beta/\gamma]^2+t)+(\upsilon+n)t}, \text{ and}$$

$$g=\frac{t\upsilon}{s([\upsilon+n][\beta/\gamma]^2+t)+(\upsilon+n)t},$$

then equation (A4) reduces to:

$$\rho=1-\frac{\Theta^{-1}t^2 s}{(s[n\{\beta/\gamma\}^2+t]+nt)^2}. \tag{A5}$$

Let $k=s(n[\beta/\gamma]^2+t)+nt$. Note that:

$$\gamma\Theta h=\frac{s(\beta/\gamma)}{k}=\frac{srg\Theta}{k}=\frac{srt}{k^2},$$

which implies:

$$\Theta^{-1}\frac{t^2 s}{k^2}=r^{-1}t\gamma h. \tag{A6}$$

Substituting equation (A6) in equation (A5) yields $\rho=1-r^{-1}t\gamma h$, or:

$$\gamma h=rt^{-1}(1-\rho). \tag{A7}$$

Alternatively, if one substitutes the relation $\Theta^{-1}=\upsilon-g\upsilon-\beta h\upsilon$ into equation (A4) then it reduces to:

$$\begin{aligned}\rho&=\upsilon^{-1}\Theta^{-1}+n\Theta(1-\upsilon^{-1}\Theta^{-1})^2+\Theta t(\gamma h)^2, \text{ and}\\&=\upsilon^{-1}\Theta^{-1}+n\Theta(1-\upsilon^{-1}\Theta^{-1})^2+\Theta r^2t^{-1}(1-\rho)^2,\end{aligned} \tag{A8}$$

using the fact that $\gamma h=rt^{-1}(1-\rho)$ from equation (A7). Equation (A8), in turn, implies:

$$n=\Theta^{-1}(1-\upsilon^{-1}\Theta^{-1})^{-2}(\rho-\upsilon^{-1}\Theta^{-1}-r^2t^{-1}\Theta[1-\rho]^2). \tag{A9}$$

Finally, substituting the expression for β determined in equation (A3) and n determined in equation (A9) into equation (A1) yields:

$$\mathrm{Var}[\tilde{\Delta}|\cdot]=\beta^2(v+n)=v-\Theta^{-1}(2-\rho)-r^2(1-\rho)^2t^{-1}.$$

We point out that this result and, thus, Propositions 1 and 2 that rely on it, can be extended to the case of signals with idiosyncratic noise terms with different variances: that is, $s_a \neq s_b$ for all agents a and b. Q.E.D.

Proof of Lemma 5

By definition, net demand is defined by:

$$\begin{aligned} D_a-D_{0a} &= r\Theta(E[u|y_a,p]-p)-D_{0a}, \\ &= r\Theta(m+(g,h)(y_a-m,p-E[p])'-p)-D_{0a}, \\ &= r\Theta(g(y_a-m)-(1-h)(p-E[p])+m-E[p])-D_{0a}, \text{ and} \\ &= r\Theta(g(u+\eta+\epsilon_a-m)-(1-h)(\alpha+\beta(u+\eta)-\gamma z-E[p]) \\ &\quad +m-E[p])-D_{0a}. \end{aligned} \tag{A10}$$

Note, however, that $\beta=g(1-h)^{-1}$ and $\gamma=(r\Theta[1-h])^{-1}$, which implies that equation (A10) can be rewritten as:

$$D_a-D_{0a}=r\Theta g\epsilon_a+z-D_{0a}.$$

Consequently, the variance of $\tilde{D}_a-D_{0a}$ is:

$$\begin{aligned} \sigma^2 &= E[(r\Theta g\tilde{\epsilon}_a+\tilde{z})^2], \\ &= (r\Theta g)^2 s+v. \end{aligned}$$

Note, however, that:

$$(r\Theta g)^2 s=\frac{r^2t^2s}{(s[n\{\beta/\gamma\}^2+t]+nt)^2}=r^2\Theta(1-\rho),$$

using the expression developed for ρ in equation (A5). Thus, σ^2 reduces to:

$$\sigma^2=r^2\Theta(1-\rho)+v.$$

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An Investigation of the Influence of a Nonstatistical Decision Aid on Auditor Sample Size Decisions

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ABSTRACT: A between-subjects experiment was used to examine the effects of a decision aid in the AICPA's *Audit Sampling* Audit Guide on the magnitude and variability of auditor sample size judgments. Audit seniors were given background case information for a hypothetical audit task and were randomly assigned to one of three experimental groups: (1) an intuitive judgment group, (2) a decision aid group who calculated sample sizes using the AICPA Guide formula, or (3) a group who provided only the formula parameters from which the researchers later computed implied sample sizes. It was hypothesized that the sample sizes of group 2 would be larger than those of group 1 (due to insensitivity to power considerations), and that the implied sample sizes for group 3 would exceed those of group 2 (due to a tendency for auditors to "work backwards" toward an intuitive sample size). Both of these hypotheses were supported by the data. However, a test for differences in variability indicated that the decision aid led to a greater degree of inconsistency in sample size judgments. Results were consistent over two levels of internal control.

THERE has been considerable interest and concern by practitioners and researchers regarding auditors' judgmental (nonstatistical) sample size decisions. For example, an AICPA Auditing Research Monograph by Mock and

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Turner (1981) used a prototypical case to examine the effect of internal accounting control changes and several types of guidance on sample size choice. At about the same time that the Mock and Turner study was conducted, the Auditing Standards Board was considering sampling issues, and eventually issued SAS No. 39 (AICPA 1981), entitled "Audit Sampling." It provided overall guidance on statistical and nonstatistical audit sampling, and required auditors to take certain planning considerations into account when determining sample sizes. SAS No. 39 was followed by an Audit and Accounting Guide (Guide) (AICPA 1983), also entitled "Audit Sampling." It provided detailed guidance on how to apply SAS No. 39. A major portion of the Guide addressed nonstatistical sampling. In particular, the Guide provided a quasi-statistical formula (and tables) for determining nonstatistical sample sizes.

The objective of this paper is to examine the effect of the nonstatistical sampling decision aid suggested by the Guide on sample sizes and their variability. While the Guide makes it clear that SAS No. 39 does not require the auditor "to compare the sample size for a nonstatistical sampling application with a corresponding sample size calculated using statistical theory" (p. 56), we suspect that many audit firms apply the techniques suggested in the Guide to demonstrate compliance with SAS No. 39. This conjecture is supported by a survey conducted by the Audit Sampling Implementation Task Force of the AICPA, who reported that the Guide was used for audit sampling applications by 28 percent of the 15 largest audit firms and by 68 percent of other large firms (Akresh and Tatum 1988).[1] In addition, the nonstatistical sample size formula sanctioned by the Guide has appeared in at least one auditing text (Carmichael and Willingham 1987, 254).

The remainder of this paper has four sections. In the first section, the background of the study is presented along with the research hypotheses. The second section describes the research method. This is followed by a results and discussion section. The last section presents concluding comments.

Background and Development of Hypotheses

The Guide explicitly recognizes that in many audit contexts, a statistical approach to audit sampling may not be cost-justified. However, even where a nonstatistical approach is elected, the Guide states that the auditor is still responsible for selecting a sample size sufficient to control the percentage risk of incorrect acceptance (or 1 − audit assurance from the test). For nonstatistical applications, the Guide provides a quasi-statistical decision aid with the objective of illustrating "a method of assisting an auditor in gaining an understanding of the relative size of samples for substantive tests of details" (AICPA 1983, 58).

The specific decision aid suggested by the Guide and examined in this study is the following formula (see AICPA 1983, 59–64 for details):

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[1] One possible reason for the lower percentage reliance on the Guide by the 15 largest firms is that some of those firms have developed proprietary sample size worksheets, such as the Peat Marwick approach described by Libby (1981, 111–112) and Elliott (1983). Peat Marwick's substantive test of details worksheet (Elliott 1983, 11) requires judgments very similar to the Guide. One major difference is that Peat Marwick has a structured form for determining tolerable error.

$$\text{Sample Size} = \frac{\text{Population's Book Value}}{\text{Tolerable Error}} \times \text{Assurance Factor.}$$

In this equation, tolerable error relates to the auditor's preliminary estimate of materiality. The Guide provides a table of six values for assurance factors based on combinations of three levels of desired audit assurance (substantial, moderate, or little) and two levels of error expectation ("little or no" error or "some" errors expected).

The AICPA formula is based on the statistical theory underlying probability proportional to recorded size (PPS) sampling (e.g., see Roberts 1978, 116–125; AICPA 1983, 74–76). Since the probability of selection is proportional to recorded value, PPS is, in effect, a stratified selection of physical units. The choices of substantial, moderate, or little desired audit assurance correspond to PPS risks of incorrect acceptance of 5.0 percent, 10.0 percent, and 22.3 percent, respectively. For error expectation, the decision aid column for "little or no error" corresponds to a PPS critical error rate of zero, while the assurance factors for "some" error correspond to PPS critical error values between one and two sampled items for which errors are expected.

Our characterization of the AICPA Guide's formula and tables as an audit decision aid follows Ashton and Willingham (1988), who in turn adopted Rohrmann's (1986, 365) definition that a decision aid is "any explicit procedure for the generation, evaluation, and selection of alternatives (courses of action) that is designed for practical application and multiple use." Ashton and Willingham (1988) point out that decision aids may have both positive and negative effects. Specifically, decision aids may (1) increase the importance of judgments since auditors will usually be required to provide the decision aid inputs, (2) increase the structure of the input data, (3) lead to justification of decision aid outputs, (4) increase or decrease judgment consistency, and (5) allow a user to circumvent the intended use. With respect to the AICPA Guide's nonstatistical sampling formula, this study provides direct evidence on items (4) and (5), as well as primary evidence on systematic differences between formula-assisted sample judgments and those elicited from unaided intuition.

We are first interested in whether the Guide's sample size formula systematically affects required sample size judgments. Tversky and Kahneman (1971, 1974) and Kahneman and Tversky (1972) present evidence that individuals substantially exaggerate the informativeness of small samples. They use the label "belief in the law of small numbers" to refer to this phenomenon. Of particular relevance here is Tversky and Kahneman's (1971) suggestion that this effect may also occur when sample sizes are being *planned*. In one of their scenarios (p. 107), subjects were presented with a case in which a doctoral student's "results are generally inconclusive, but one before-after comparison yields a highly significant $t = 2.70$, which is surprising and could be of major theoretical significance." Subjects were then asked whether the study should be replicated, given this surprising result and, if so, what replication sample size would be necessary. The median sample size recommendation was 20 for the 66 subjects (out of 75) who indicated that the study should be replicated. This median response was much too small to produce a similar t-statistic, assuming that the mean and variance in the second sample were identical to those in the first sample.

In brief, one can interpret the law of small numbers as a cognitive bias in which individuals recognize that larger samples provide greater assurance, but understate the extent to which statistical power diminishes as sample sizes are reduced, with a resultant tendency to attribute too much power to a relatively small sample. It is reasonable to expect that in the planning of nonstatistical audit samples, this bias might be manifest as a preference for sample sizes too small to provide the desired audit assurance. To the extent that a sample size decision aid might remove such a bias by forcing the auditor to concentrate on audit assurance and tolerable error rather than directly on the sample size, the use of such a decision aid would be expected to result in increased sample sizes, leading to the first hypothesis:

> H1: Subjects using the decision aid will tend to recommend larger sample sizes than subjects making unaided intuitive sample size decisions.

There are at least three forces that might work against H1. First, H1 implies that the decision aid will generate normatively correct sample sizes that can be appropriately compared to intuitive sample size judgments. However, the Guide's formula cannot be strictly interpreted as providing normatively correct sample sizes. As indicated above, the Guide's formula and table are based on PPS selection and sampling theory. In effect, PPS selection is equivalent to stratified selection of physical units, which is more difficult to perform than random selection. Furthermore, the assurance factors presented in the Guide represent the judgments of the AICPA Audit Sampling Subcommittee as to the correspondence between formal PPS risk factors and qualitative descriptions of audit assurance and error expectation. However, there may be disagreement as to whether, for example, "moderate" desired audit assurance implies a 10.0 percent allowable risk of incorrect acceptance, or whether "little or no error" should correspond to the zero error rate PPS risk factors. At best, the Guide's assurance factors can be taken as informed interpretations sanctioned by the regulatory body responsible for setting auditing standards in the United States.

Since the AICPA decision aid cannot be interpreted as a normative benchmark, we worded the experimental case information to request a physical unit sample size, with no mention of stratification. Thus, the test of H1 is intentionally biased toward the null, because when units of different sizes are sampled with equal probability, a PPS-based sample size will be too small to provide the desired assurance. Even if a minimal stratification strategy is used, the Guide acknowledges that the output of its formula will, in general, be too low. As an illustration, the Guide recommends that with only minimal stratification, an auditor should sample 110 items when the sample size computed by the formula is 80 (AICPA 1983, 60). Appropriate sample sizes would be higher yet when *no* stratification is planned, as in our experimental task.

A second force that may work against H1 is the possible effect of population size on intuitive sample sizes. Population size is statistically irrelevant for sample size judgments about large populations.[2] However, if individuals *believe* that population size is important, as suggested by Bar-Hillel (1979) and Evans and Bradshaw (1986), H1 might not hold for larger populations. The present study indicated a population size of 6,000 items.

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[2] The Guide itself indicates that the normative effect of population size on sample size is very small for populations greater than 1,000, and is negligible for populations greater than 5,000 (AICPA 1983, 35).

A third and final threat to H1 was raised by Ashton and Willingham (1988): individuals can circumvent the intent of a decision aid. That is, H1 is predicated on the assumption that individuals will use the decision aid as it was intended to be used. However, auditors can circumvent the AICPA decision aid by working backwards, starting with a desired sample size and forcing the requisite decision aid parameters in an attempt to justify a sample size that is fundamentally based only on intuition. Such a strategy might be used by an auditor who is dissatisfied with the size of the sample generated by the decision aid and, therefore, manipulates parameter values as necessary to yield a sample size which is more intuitively reasonable.

The following experimental hypothesis addresses this "working backwards" possibility:

H2: Sample sizes computed by subjects using the decision aid will be systematically lower than the sample sizes implied by the decision aid *parameter judgments* of a separate group of subjects who are not asked to compute sample sizes.

The rationale behind H2 is that if an individual is asked only for the input parameters of the decision aid, then that individual will not have the opportunity to work backwards. That is, if auditors work backwards because they feel that the decision aid's output is unreasonable, one way to remove this incentive (or at least make it far less likely) is to ask auditors to supply only the inputs to the decision aid without calculating the output (sample size). If *both* H1 and H2 hold, there would be evidence that the decision aid increases sample sizes to some extent even when auditors can circumvent its intended directional flow, but that greater increases are implied when auditors cannot do so.

Ashton and Willingham (1988) point out that beyond systematic changes in the magnitude of judgments, a decision aid can affect the *variability* of judgments. However, as they also indicate, the literature on the effect of decision aids on judgment dispersion is mixed. In auditing, Ashton (1983) and Elliott (1983) have proposed that structured decision aids would reduce the inconsistency of auditors' judgments. Mock and Turner (1981, 122) called for the development and study of automated judgment processes as a possible means for reducing the considerable variability they observed in their experimental results. However, in auditing (Daniel 1988; Jiambalvo and Waller 1984) and in other disciplines (Burns and Pearl 1981; Chakravarti et al. 1979), there is evidence that decomposing a global judgment into several smaller underlying judgments does not necessarily lead to improvement in accuracy and may actually increase dispersion.

Since the evidence on the effect of a decision aid on judgment variability is inconclusive, we conduct a two-tailed test of the following null hypothesis:

H3: Use of the decision aid will have no effect on the dispersion of inter-auditor sample size decisions.

Hypotheses 1 through 3 comprise the primary focus of the study. However, since the reliance on internal control is a critical factor in substantive sample size judgments, we also consider whether conclusions regarding these hypotheses generalize across different levels of internal control. Thus, tests are conducted over two levels of internal control to assess any such interaction effects.

Method

Case Materials and Experimental Conditions

The basic case used in all experimental conditions included background information and a set of financial statements for a manufacturer of various parts for small consumer appliances.[3] The subjects were instructed to direct their attention to the supplies inventory account and were told that "the inventory of supplies is considered material to the financial statements taken as a whole, but is not so critical as to warrant formal statistical analysis." They were then told that the audit manager wanted to apply nonstatistical sampling to the subsidiary records. A list of proposed audit procedures was provided.

Subjects were also provided with information on the internal controls, expectation of errors, and other substantive tests for the supplies inventory. There were two internal control (and related error expectation) conditions. The weak internal control condition cited a number of control weaknesses, discussed prior-year weakness recommendations not completely corrected, and implied an expectation of error. The strong internal control condition cited implementation of new controls to correct the cause of prior-year errors. It was further stipulated that audit compliance tests indicated that the new controls were operating as described. The manipulation of internal control in this study is similar to that of Mock and Turner (1981), whose two conditions were "weak to fair" and "weak to strong." The nature of other substantive tests was held constant in all experimental conditions.

There were three experimental conditions for each of the two internal control environments (a 3×2 two-factor design). The basic task for subjects was the determination of a nonstatistical sample size for the supplies inventory. The three experimental conditions for the sample size selection task were: (1) an intuitive judgment group who provided a sample size without the decision aid (intuitive group); (2) a decision aid group who calculated sample size using the formula (decision aid group); and (3) a group who provided only the parameters for the formula with the researchers calculating the sample size afterwards (parameters only group). Instructions for each experimental condition are shown in the Appendix. Description of the steps of the decision aid and definitions of parameters were taken virtually verbatim from the Guide (AICPA 1983, 59–60).

Subjects and Procedure

Two Big Eight auditing firms participated in the study. The two firms differed widely in the extent of structure in their audit procedures, as categorized by Kinney (1986). Auditor subjects from each firm were randomly assigned to one of the six treatment groups. The instruments were administered at three senior-level training sessions.

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[3] A copy of the case is available from the authors.

Because of the transparent differences between experimental conditions, a between-subjects design was used to guard against potential demand effects that might otherwise threaten the validity of experimental conclusions. For one firm, the study was conducted in person by one of the researchers as part of the training programs (129 subjects; two administrations). For the other firm, the instruments were placed in individual envelopes and mailed to a firm representative (47 subjects; one administration). A letter from the coordinating partner was attached to each envelope encouraging participation. The envelopes were handed to the participants at the beginning of the course and returned at the end of the week to the course coordinator. The envelopes were then returned to the researchers. All subjects were advised in a cover letter of the importance of working independently.

A total of 176 auditors with an average of 3.1 years of experience participated in the study. Twenty-four subject responses were deleted, leaving 152 usable responses. Proportional deletions were not significantly different from expected values based on the firms' proportional participation in the experiment. The majority of deletions (18) resulted from one of two causes: either (1) parameter values were provided but sample size was not computed, or (2) there was a large error in the computation of sample size.[4] Usually both causes could be attributed to the fact that some subjects assigned to the decision aid group did not bring a hand calculator.[5] Since part of this study is concerned with whether subjects revise their judgments after determining the result of the decision aid, we felt that it was necessary to exclude these responses. However, results were not significantly different when we calculated sample sizes or corrected these responses and included them in the analyses.

Results and Discussion

This section presents test results. Table 1 provides descriptive statistics on sample size decisions for each of the treatment conditions. In order to ensure that the internal control manipulation was successful, the subjects who participated in the final administration of the experiment were asked to evaluate internal control strength on a 1 (very weak) to 10 (very strong) scale. The average ratings were 5.43 for the weak condition and 7.15 for the strong condition, and are significantly different ($t=4.393$; $p<.001$). Since sample size responses showed a high degree of positive skewness, nonparametric statistical approaches were used to test each of the hypotheses.

Decision Aid Effects on Sample Size

Hypothesis 1 predicts that the sample sizes of the intuitive group would be

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[4] The other six deletions were due to blank responses (4), a nonsensical response (1), and a range for tolerable error (1).

[5] Since subjects were randomly assigned to experimental conditions and only one-third of the subjects (those assigned to the decision aid group) needed to perform any calculations, it was not practical to arrange for each such subject to have a hand calculator. We anticipated a higher proportional deletion rate for the decision aid group for this reason, so we included slightly more instruments for the decision aid group in order to achieve approximately equal cell sizes for the usable responses.

Table 1
Auditor Subjects' Sample Size Decisions by Experimental Condition

	Experimental Group (Instructions)		
Internal Control Condition	*Intuitive*	*Decision Aid*	*Parameters Only*
Weak:			
Mean	74	90	191
Median	50	60	100
25% Quartile	30	44	75
75% Quartile	68	110	150
Range	10–600	6–396	38–1503
Interquartile range	38	66	75
n	24	24	27
Strong:			
Mean	47	61	79
Median	30	56	60
25% Quartile	20	35	38
75% Quartile	53	80	100
Range	10–250	20–225	2–215
Interquartile range	33	45	62
n	23	27	27

smaller than those generated by the decision aid group because the decision aid would force auditors to focus on the audit assurance that is implicit in the formula rather than directly on the sample size. Hypothesis 2 predicts that auditors might "back into" their desired sample size by manipulating the parameters of the formula. This would suggest that the sample sizes generated by the parameters only group would be larger than those of the other two groups.

Each of the above hypotheses and the effect of control strength were jointly tested using a two-factor (3×2) ANOVA design on rank-transformed data.[6] Sample sizes were transformed to ranks following the approach of Conover (1980, 337).[7] This procedure has been extensively tested for power and reliability by Iman (1974). Use of the rank transform has the additional benefit of removing any mean shift induced solely by a change in the dispersion of the response distribution. Since the distribution of sample sizes is by definition bounded from below by zero, a change in the variance of responses may itself induce a change in the average sample size. For example, if sample sizes of the decision aid group relative to the intuitive group are more varied, one would expect a higher mean due to the larger number of positive outliers. However, the median value of the distributions would not be affected, nor would the average rank of the composite

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[6] Additional analyses were run where observations were randomly deleted as necessary to achieve equal cell sizes. These analyses produced substantially identical results.

[7] Theoretical justification for this procedure rests on the observation that the nonparametric Kruskal-Wallis test (or the Mann-Whitney *U*-test, in the case of two levels) is statistically equivalent to a one-way ANOVA on ranked data. This reasoning has been extended to the two-factor case with interaction by Scheirer et al. (1976).

Table 2
Effect of the Decision Aid on Ranked Sample Size Decisions
($n=152$)

Panel A. Analysis of Variance:

Factors	*df*	*Sum of Squares*	*F-statistic*	p≤
Experimental Groups (*EG*)	2	47,855	15.31	.001
Internal Control (*IC*)	1	14,320	9.16	.003
EG×*IC*	2	1,628	0.52	.595
Error	146	228,183		

$R^2=.219$

Panel B. Pairwise Comparisons Between Treatment Means:

Treatment Differences	*t-statistic*	*One-Tailed* p≤
Decision Aid (*DA*)−Intuitive (*I*)	2.97	.002
Parameters Only (*PO*)−*DA*	2.58	.006
PO−*I*	5.53	.001

distributions. Therefore, rank-transformed ANOVAs capture only that shift caused by treatment factors, unaffected by artifactual differences due to increased sample dispersion.

The ANOVA source table for sample size decisions is shown in Table 2, Panel A.[8] The experimental group factor was statistically significant at $p<.001$. Pairwise comparisons between the treatment means for each of the experimental groups (Panel B) showed that each was significantly different in the hypothesized direction.[9] Thus, there is fairly strong support for both H1 and H2. To corroborate the ANOVA results, we also conducted Jonckheere tests for ordered alternatives (Hollander and Wolfe 1973, 120–121), which take advantage of the partial prior information inherent in the hypotheses that sample sizes would be highest in the parameters only group, followed in order by the decision aid and intuitive groups. The normal approximations to the Jonckheere test statistic were highly significant for both the weak ($z=3.98$; $p<.001$) and strong ($z=3.25$; $p<.001$) internal control conditions, supporting the postulated ordering.

Panel A of Table 2 also shows that sample sizes were significantly smaller when the internal control environment was relatively strong. However, there was no significant interaction effect between the experimental group factor and the internal control factor. This provides evidence that the primary treatment effects hold over different levels of internal control.

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[8] A conventional ANOVA on raw data with the three largest outliers (sample sizes of 600, 752, and 1,503) removed yielded results closely paralleling the reported findings.

[9] Since we conduct three pairwise comparisons in Table 2 but only have two degrees of freedom for the experimental treatment factor, a correction for familywise error is appropriate (see Keppel 1982, 148). The modified Bonferroni correction procedure would establish our critical alpha level for the pairwise comparisons at two-thirds of the critical alpha used for the omnibus treatment effect. Defining the latter as .05 yields a critical *p*-value of .033 for the pairwise comparisons. Each of our computed *p*-values is well below this critical value.

Discussion: Hypothesis 1. Results support our conjecture that the use of the Guide's decision aid results in systematically larger judgmental sample sizes. Sample sizes computed by the decision aid group were much higher than those of the intuitive group at each quartile of the response distributions for both internal control conditions. If one accepts the premise that insensitivity to power considerations results in Tversky and Kahneman's (1971) "belief in the law of small numbers," and if one further grants that the practical manifestation of such insensitivity might be a bias towards smaller planned audit sample sizes, then a case might be made for a normative statement in favor of the decision aid.

Discussion: Hypothesis 2. The sample sizes computed by the researchers from the parameter judgments of the parameters only group were even higher than those computed directly by the decision aid group. This result suggests that responses were influenced to some degree by the "working backwards" effect. Apparently, not only did the parameter judgments of the decision aid group affect their sample sizes, but also the reverse was true: desired sample sizes afffected the choice of decision aid parameters.

Descriptive information regarding the parameter values provided by subjects in the decision aid and parameters only groups is shown in Table 3. Additional analyses of these parameters indicated the following. First, a two-factor ANOVA on rank-transformed tolerable error judgments showed that the values provided by the parameters only group were significantly lower than those of the decision aid group ($F=5.70$; $p=.019$), which would lead to higher sample sizes. The internal control factor was not significant. The subjects' choices of the desired level of assurance and error expectation were examined with contingency table analyses. The only significant differences for these parameters occurred in the strong internal control condition. For the assurance level judgments, the two-tailed test yielded $p=.035$, but the parameters only group actually demanded a *lower* level of assurance, which would tend to reduce rather than increase sample sizes. We have no explanation for this (possibly chance) effect, which runs counter to the sample size result in Table 2. Finally, the parameters only group tended to elect the higher error expectation choice at a marginally significant $p=.100$. We conclude that most of the sample size differences between the decision aid and parameters only groups can be attributed to differences in tolerable error judgments.

Firm effects. As previously indicated, the two auditing firms which participated in this study differed in their internal use of structured audit approaches (see Cushing and Loebbecke 1986; Kinney 1986). A recent study by Bamber and Snowball (1988) suggested that differences in audit firm structure might account for systematic differences in sample size judgments. Firm differences were tested using a ranked data ANOVA similar to Table 2 with *FIRM* added as a main effect and as an interaction term with the other factors.[10] The main effects for experi-

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[10] Since cell sizes become highly unbalanced when *FIRM* is added as a factor, the sums of squares used to analyze results of the ANOVA were computed as if each factor were the last to enter the model. Such a procedure is statistically equivalent to ordinary multiple regression using indicator variables to represent model factors.

Table 3
Descriptive Statistics on Decision Aid Parameters

	Internal Control			
	Weak		*Strong*	
	Decision Aid	*Parameters Only*	*Decision Aid*	*Parameters Only*
Tolerable Error (thousands):				
Mean	$389	$161	$220	$287
Median	250	150	188	190
25% Quartile	138	100	140	100
75% Quartile	450	200	250	250
Range	38–2500	10–375	100–500	38–2500
Interquartile range	312	100	110	150
Desired Audit Assurance:				
Frequencies (percentages):				
Substantial	8 (33%)	4 (15%)	8 (30%)	1 (4%)
Moderate	15 (63%)	20 (74%)	15 (55%)	19 (70%)
Little	1 (4%)	3 (11%)	4 (15%)	7 (26%)
χ^2 statistic	2.88		6.73	
p-value	.237		.035	
Error Expectation:				
Frequencies (percentages):				
Little or no error	2 (8%)	1 (4%)	18 (67%)	12 (44%)
Some errors expected	22 (92%)	26 (96%)	9 (33%)	15 (56%)
χ^2 statistic	0.49		2.70	
p-value	.483		.100	

mental groups (*EG*) and internal control continued to be highly significant. The only firm effect which approached statistical significance was the *FIRM*×*EG* interaction ($F=3.29$; $p=.040$). A plot of this interaction is presented in Figure 1, which indicates that the decision aid had a more pronounced effect for the relatively unstructured firm.[11]

The structured firm that participated in the study uses a nonstatistical sample size decision aid by firm policy. One interpretation of the interaction effect shown in Figure 1 is that the auditors from the structured firm have to some extent internalized the reasoning behind the decision aid into their *intuitive* sample size judgments, thereby diminishing the difference between intuitive and decision aided sample sizes for the structured firm.

Supplementary test of H2. We attributed differences between the sample size judgments of the decision aid and parameters only groups to a working back-

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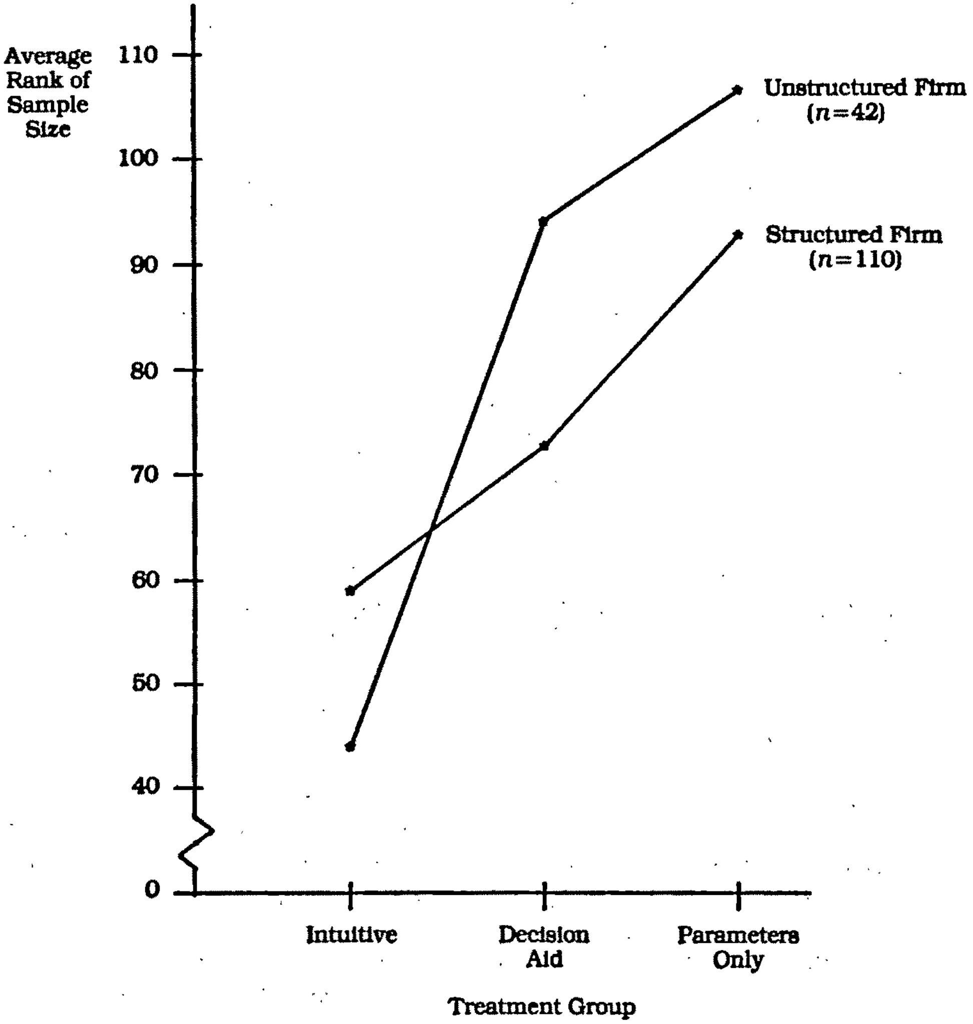
[11] Since the experimental instrument was administered in person for the structured firm but was administered by mail for the unstructured firm, it is possible that any firm effects could in fact be attributable to differential administration effects. While this possibility cannot be dismissed, it is unlikely, since (1) all subjects were instructed to work independently, and (2) even if the subjects from the firm that completed the instrument outside of class ignored the instruction to work independently and talked to each other, this would probably lead to greater consensus and would work against the interaction effect found.

Figure 1
Plot of Firm × Experimental Group Interaction



wards phenomenon. To corroborate this conclusion, an additional 28 subjects (14 randomly assigned to each internal control condition) were provided with a combined instrument and asked for an intuitive sample size followed by a sample size computed from the AICPA formula. The intuitive and decision aided sample sizes were close for most of these additional subjects. The respective means were 78 and 74 (44 and 52) in the weak (strong) internal control condition. Wilcoxon signed rank tests conducted separately for each internal control condition showed no significant differences at conventional levels between intuitive and decision aided judgments. We interpret this repeated-measures result as providing further support for behavior consistent with the working backwards explanation.

Table 4
Effect of the Decision Aid on Sample Size Variability
($n=152$)

Panel A. Analysis of Variance:

Factors	*df*	*Sum of Squares*	*F-statistic*	p≤
Experimental Groups (*EG*)	2	3.172	4.89	.009
Internal Control (*IC*)	1	1.244	3.84	.052
EG×*IC*	2	0.290	0.45	.640
Error	146	47.309		

Panel B. Orthogonal Treatment Comparisons:

Comparison	*df*	*Sum of Squares*	*F-statistic*	*Two-Tailed* p≤
Intuitive (*I*) vs. average of Decision Aid (*DA*) and Parameters Only (*PO*)	1	1.865	5.76	.018*
DA vs. *PO*	1	1.299	4.01	.047
Imprecision due to unbalanced cell sizes		0.008		
Treatment SS for *EG*	2	3.172		

* Average transformed ranks from the modified Fligner and Killeen (1976) test for homogeneity of variance were .629 for the intuitive group, and .866 for the average of the decision aid and parameters only groups. Hence, there is statistical evidence that the sample size judgments of the intuitive group were significantly less variable than those of the other two groups.

Decision Aid Effects on the Variability of Sample Sizes

While hypotheses 1 and 2 examine the effect of the Guide's sample size decision aid on the *magnitude* of sample size decisions, hypothesis 3 focuses on the *dispersion* of those decisions between auditors. Conventional tests of differences in sample variance which assume normal distributions are particularly sensitive to the assumption of normality and, as noted above, the data of this study were highly skewed. Thus, H3 was tested with a version of a nonparametric test for differences in dispersion suggested by Fligner and Killeen (1976), as modified by Conover et al. (1981). The procedure involves an ANOVA on data obtained by transforming the rank of the absolute difference between each observation and its corresponding cell median. The transformation used is $\Phi^{-1}(.5+i/2(N+1))$, where Φ^{-1} represents the inverse standard normal distribution function, i is the ranked absolute value, and N is the combined sample size of all experimental cells. The transformed ranks provide a measure of the *relative* dispersion between experimental cells.

The results of this analysis are presented in Table 4. Average transformed ranks for the three experimental groups were .629, .755, and .977, respectively, indicating that the sample size responses of the intuitive group were *less* variable than those of the decision aid group, and the sample sizes of the decision aid group were less variable than those of the parameters only group. The overall experimental group factor was statistically significant ($p = .009$). Two orthogonal pairwise comparisons were conducted.[12] First, the intuitive group was compared to the average of the decision aid and parameters only groups. This comparison showed the judgments of the intuitive group to be significantly less disperse than those of the other two groups ($p = .018$). There was also evidence of a significant difference between the decision aid and parameters only groups ($p = .047$).

The internal control factor was marginally significant ($p = .052$), indicating that sample size responses were more disperse when internal control was weak than when internal control was strong (average transformed ranks of .885 and .702, respectively). However, there was no interaction between experimental groups and internal control ($p = .640$). The absence of any interaction effect indicates that the tests of hypothesis 3 are insensitive to the assumed strength of internal control.

Discussion: Hypothesis 3. The results indicate that the Guide's decision aid increased the dispersion of sample size responses. Thus, the predictions of Mock and Turner (1981) and others as to the effects of an automated judgment process on variability are not supported. By way of explanation, it may be that the Guide's decision aid is not as "automated" as it might appear. That is, the nonstatistical sample size formula of the Guide simply replaces one intuitive judgment (sample size) with three other intuitive judgments (tolerable error, degree of desired assurance, and error expectation). Sample size variability for the decision aid and parameters only groups simply reflects the extent that auditors disagree as to the values of these underlying parameters. For the auditors in this study, it appears that this underlying disagreement was larger than the disagreement between unaided sample size judgments of the intuitive group.

Much of the dispersion of the sample size distributions for the decision aid and parameters only groups can be attributed to the tolerable error parameter (see Table 3). This, in turn, suggests the importance of financial statement materiality or its single audit test analog—tolerable error. If auditors differ as to the magnitude of allowable error, then a sample size decision aid which is sensitive to materiality judgments will not generate consistency of responses. One possible reason for the high variability of tolerable error judgments is that some auditors may define tolerable error for the particular account being audited whereas others may use the error that is tolerable for the financial statements taken as a whole. Since the Guide is somewhat ambiguous on this point and the experimental instructions for the decision aid and parameters only groups were taken verbatim from the Guide (AICPA 1983, 59), it is possible that the Guide's definition of tolerable error accounts for part of the observed results.

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[12] In conducting pairwise comparisons following the ANOVA for dispersion metrics, we used the advice of Keppel (1982, 113–114), who suggests that when one of the groups represents a control condition, its mean should be compared to the average of the treatment conditions. This comparison is followed by an additional test of differences between the specific treatments (decision aid and parameters only, in our case). Pairwise tests constructed in this manner have the property of orthogonality (Keppel 1982, 118–123), such that they reconcile to the total sum of squares explained by the treatment factor. Note that we *did not* follow this approach in the analysis of differences in sample size *magnitude*, since there we had prior reason to believe that the intuitive-decision aid difference would be less pronounced than the intuitive-parameters only difference, suggesting pairwise comparisons between each experimental group.

Concluding Comments

This study examined the effects of a recently promulgated nonstatistical sample size decision aid (AICPA 1983) on the sample size judgments of auditors. The decision aid led to systematically larger sample sizes than those elicited from unaided intuitive judgment. Sample sizes were even larger when subjects were asked only for the decision aid parameter values, suggesting that at least some subjects worked backwards in an attempt to circumvent the decision aid. We interpret these results as indicating that the decision aid may be acting to remove a judgmental bias that Tversky and Kahneman (1971) referred to as belief in the "law of small numbers." However, any decision aid benefits attributable to removing the "law of small numbers" must be weighed against possible detrimental effects on the variance of responses. Our tests indicated that the use of the decision aid resulted in more variance in auditor sample size judgments. Neither the magnitude nor the variability effects of the decision aid were sensitive to the level of internal control. The tolerable error parameter of the decision aid was responsible for much of the observed variability and for the difference between the sample sizes of the decision aid and parameters only groups which we attributed to a working backwards phenomenon.

Our conclusions are qualified by two limitations. First, Bar-Hillel (1979) and Evans and Bradshaw (1986) showed that individuals' sensitivity to sample size may be a function of population size, which we held constant. Although a large population size was used such that any population effect would likely work against the experimental hypotheses, the results may not generalize across population sizes. Second, in any experiment using case information, subjects may be responding to some assumed feature of the task which has nothing to do with its formal structure (Evans and Dusoir 1977, 136). For example, it is possible that some subjects may have assumed some sort of stratification plan, even though the case called for an unstratified physical units sample.

In sum, the results here support the conjectures of Ashton and Willingham (1988) that decision aids may have both positive and negative effects.

Appendix

Experimental Instructions

[INTUITIVE GROUP:]

OBJECTIVE:

Please indicate your intuitive judgment of the desired number of sample items for the detail test of the supplies inventory just described. Please take into consideration the descriptions of balance sheet and income statement values, internal control characteristics, other substantive audit procedures, and error expectations.

I would recommend a sample size of ☐ inventory items.

[DECISION AID GROUP:]

OBJECTIVE:

Please compute your determination of the required sample size for the detail test of the supplies inventory just described. Your computation should be based on the following nonstatistical sample size model, taken from the 1983 AICPA *Audit Sampling* guidebook (Guide):

$$\text{Sample size} = \frac{\text{Population's recorded amount}}{\text{Tolerable error}} \times \text{Assurance factor}$$

Since the population's recorded amount is known to be $3,758,000, you only need to assess the tolerable error and assurance factor. These terms are defined in the Guide as follows:

[Parameter definitions and the assurance factor table
from the Guide were provided here.]

SAMPLE SIZE COMPUTATION:

$$\text{Sample size} = \frac{\text{Population's recorded amount}}{\text{Tolerable error}} \times \text{Assurance factor}$$

$$\boxed{} = \frac{\$3{,}758{,}000}{\boxed{}} \times \boxed{}$$

[PARAMETERS ONLY GROUP:]

OBJECTIVE:

It is generally a good idea to identify the characteristics of an audit population before determining the extent of detail audit test procedures. Please provide your judgments on three such characteristics: tolerable error, desired degree of audit assurance, and error expectation, as related to the detail tests of supplies inventory for Modern Products Corporation.

[Parameter definitions from the Guide were provided here.]

1. Based on the information provided, my judgment of tolerable error for Modern's supplies inventory is $__________.

2. Based on the information provided, I would classify the desired degree of audit assurance for Modern's supplies inventory as:
   ______ Substantial
   ______ Moderate
   ______ Little

3. Based on the information provided, I would expect:
   ______ Little or no error in the detail test of Modern's supplies inventory.
   ______ Some errors in the detail test of Modern's supplies inventory.

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Strategic Considerations for Unaudited Account Values in Analytical Review

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ABSTRACT: Recent research indicates that auditors' account value estimates from analytical review are affected by knowledge of the unaudited account value (or book value). The exact nature of the consequences from the auditor's use of book value for analytical review has not been formally shown and is a source of controversy. This paper examines the audit cost and risk consequences associated with the auditor's reliance on book value for analytical review. The analysis is framed within a Bayesian decision theoretic model and is conducted for a comprehensive set of audit and environmental conditions. The results include expressions for audit cost/risk when the auditor's analytical review is and is not conditioned on book value. While definitive inferences are possible only when certain intuitive criteria are used, the advantages of incorporating book value in the practice of analytical review appear minimal. That is, reliance on book value would seem to require a procedure that, if reliable, would preclude the need for analytical review (or any other audit procedures).

PRELIMINARY analytical review is an important part of planning the audit program. Recent research has shown that auditors' account value estimates for analytical review are affected by knowledge of the unaudited or book value of the account under review (Kinney and Uecker 1982; Biggs and Wild 1985; Shields et al. 1988; Heintz and White 1989). However, the audit consequences associated with use of book value for analytical review have become a point of controversy.

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The controversy centers on the appropriateness and subsequent effects, of using book value as information (evidence) for estimation of account value in analytical review. On one hand, some argue that use of book value is inappropriate due to increased audit risk and the violation of audit independence. For example, Kinney and Uecker (1982, 67) argue that for account value estimation "the only inappropriate information is the book value(s), which comprise the basis for comparison." Biggs and Wild (1985, 609–610) echo similar sentiments in arguing that:

> . . . use of unaudited book values to form an expectation about the true book value will increase the auditor's risk of not investigating accounts that are materially in error (beta risk) . . . [and also] violates the notion of independent evidence.

On the other hand, some argue in favor of using book value under certain circumstances. Shields et al. (1988) maintain that:

> . . . because unaudited book values and audit values are highly correlated, often having the same value . . . use of the former when estimating the latter may be an efficient and effective means by which to accomplish this task (p. 2). In short, the use of unaudited book values may enhance both audit efficiency and effectiveness (p. 4).

In a replication and extension of the Kinney and Uecker (1982) and Biggs and Wild (1985) studies, Heintz and White (1989) show that the auditor's account value estimate for analytical review is influenced by the availability of book value even though book value is defined as preliminary and the auditor is told that no audit procedures have been performed. Heintz and White also report that:

> . . . [m]any of the auditors who participated in this research argued in post-experiment discussions that it was appropriate to rely on the unaudited data because the instrument stated that there had been no unusual events and no major audit adjustments in prior years, and no major changes were expected in the current year. Under these circumstances, the auditors felt that it was reasonable to use the unaudited data (p. 37).

Heintz and White conclude that if this:

> . . . explanation reflects current practice, then perhaps the accounting firms or the Auditing Standards Board need to make clear the circumstances under which unaudited data can be used in analytical review (p. 37).

Thus, these prior studies yield two conclusions. First, the empirical evidence is consistent with the auditor's account value estimate being influenced by the book value under audit. Second, there is a controversy regarding whether or not auditors *should* use book value in estimating audited value. Since the likelihood of auditor awareness of book value prior to analytical review is high, it is important to analyze the audit consequences of the auditor conditioning account value estimates on book value.

The purpose of this study is to formally identify the audit cost and risk consequences associated with the auditor's reliance on book value for analytical review. The results of this analysis are conditional on a Bayesian decision theoretic framework for the auditor's decision process with linear utility. Other distinctive features of this study are (1) the use of a Bayesian framework that explicitly incorporates any dependence between auditor and manager account estimation errors, (2) the consideration of error in *both* the manager and auditor account value estimates, and (3) an emphasis on the auditor's planning decisions.

Section I presents the analytical review setting and assumptions. The results are provided in Section II for a comprehensive set of audit scenarios. Section III summarizes the findings and presents the conclusions.

I. Analytical Review Setting and Assumptions

A formal description of the analytical review setting is presented where the auditor's account value estimate is (1) *not* conditioned on book value, and (2) conditioned on book value. The basis of analysis and the important assumptions of the model are described.

Unconditional and Conditional Analytical Review

Suppose the true value of the *i*th account is denoted $V_{T,i}$. Managers' asserted (book) value of this account $E_{M,i}$ is taken from a distribution function $V_{M,i}$ of book values defined on the underlying transactions.[1] The auditor then conducts a review of $E_{M,i}$ using correlates of transactions. These correlates could be (1) actual and/or summary measures of transactions, (2) causal and/or associative factors (e.g., industry statistics), or (3) any other prior information. This review yields the auditor's estimate $E_{A,i}$ of account value taken from the distribution function $V_{A,i}$ of possible estimates.[2]

The value $E_{A,i}$ is important to an effective and efficient analytical review. In particular, the difference between $E_{A,i}$ and $E_{M,i}$, along with the noninvestigation interval, is related to (1) the risk of incorrect rejection (audit efficiency), and (2) the risk of incorrect acceptance (audit effectiveness). This difference is then compared to some prespecified value of intolerable error. For present purposes the critical level of intolerable error is taken as exogenous and is assumed to be established for the *i*th account at a level δ_i in a manner consistent with the audit program.

The controversy surrounds the use of $E_{M,i}$ as another piece of evidence in analytical review (for convenience, the *i*th notation is hereafter dropped). In that spirit, a *conditional* distribution function $V_{A|M}$ is defined, where its expected value $E_{A|M}$ is the auditor's account estimate from analytical review conditioned on the unaudited value, i.e., $E_{A|M}=f[E_A,E_M]$.[3] Operationally, the conditional expectation $E_{A|M}$ is described as a weighted linear aggregate of E_A and E_M:[4]

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[1] This distribution function is viewed as a stochastic process that is influenced by management's interpretation and application of GAAP (e.g., the selection of accounting methods and estimates). The function is not restricted to random measurement error, and can include intentional misstatements.

[2] $V_{A,i}$ can be viewed as a prior density function that incorporates both subjective and objective evidence gathered by the auditor. This function is *not* conditioned on the unaudited book value for the account under review.

[3] Consistent with the Bayesian framework for deriving the conditional review, we formally model management's assertion as exogenous. This approach is consistent with prior research in its characterization of the audit environment (Scott 1984). An alternative framework is to include management assertions as endogenous along the lines of assumed game-theoretic behavior. However, if management is not viewed as adopting strategic positions dependent on the auditor's behavior, the Bayesian and game-theoretic solutions coincide. Further, even if the audit does influence manager behavior, if the client has a "pure" strategy, and the auditor has correct conjectures about the client's equilibrium strategy, then the Bayesian and game-theoretic solutions again coincide (Fellingham and Newman 1985).

$$E_{A|M}=\omega_A \times E_A+\omega_M \times E_M, \tag{1}$$

where $\omega_M=(1-\omega_A)$.

The weights in equation (1) are determined using Bayesian techniques. The unconditional analytical review entails an assessment of account error (E_A-V_T) and the uncertainty surrounding that estimate (σ_A^2). The conditional analytical review, represented by account error $E_{A|M}-V_T$ and variance $\sigma_{A|M}^2$, depends on the auditor's assessment of account error in both the auditor's and manager's prior probability distribution, *and* the associated error covariance matrix—for convenience, call this assessment function Π.[5] In Bayesian revision, the assessment function Π serves as the likelihood function for purposes of deriving the posterior distribution of the conditional review (via information weights).[6] The determination of Π may be based on both objective and subjective evidence. For example, while prior years' audit adjustments, results of audit tests, and assessment of management integrity, are relevant information for both the unconditional and conditional reviews, the auditor's estimate of Π (including uncertainty) presumably depends on the accuracy of prior book values (Shields et al. 1988).

Another factor in obtaining the information weights is the explicit consideration given to stochastic dependence between the auditor's and manager's valuation errors. Since the auditor's decision may be based on (among other things) information which substantially overlaps with that of its client, a positive dependence among their errors is possible. Assuming this dependence is known, the Bayesian-based posterior distribution of the conditional review is defined by the expressions:

$$\omega_A=(\sigma_M^2-\rho\sigma_A\sigma_M)/(\sigma_A^2+\sigma_M^2-2\rho\sigma_A\sigma_M), \text{ and} \tag{2a}$$

$$\omega_M=(\sigma_A^2-\rho\sigma_A\sigma_M)/(\sigma_A^2+\sigma_M^2-2\rho\sigma_A\sigma_M), \tag{2b}$$

where $\rho\sigma_A\sigma_M$ is the covariance between auditor and manager expectation error. The derivation of these expressions is obtained from the posterior density function of the conditional review.[7] The variance for this density function is:

$$\sigma_{A|M}^2=[\sigma_A^2\sigma_M^2(1-\rho^2)]/[\sigma_A^2+\sigma_M^2-2\rho\sigma_A\sigma_M], \tag{2c}$$

---

[4] This assumption may not be restrictive in that prior research suggests that linear models adequately represent individuals' judgments (Dawes and Corrigan 1974).

[5] Similar to prior research, we assume that both auditor's and manager's errors can be approximated by normal distributions (Kinney 1975; Scott 1973, 1975; Beck et al. 1985). However, the results are robust for any reasonable distributional assumption (i.e., the function need only be monotonically nondecreasing). Empirical evidence suggests that auditors' probability assessments are typically symmetric and can be approximated by normal distributions (Solomon et al. 1982). Also consistent with prior research (Kinney 1975; Beck et al. 1985), we assume that the variances are known.

[6] For further details of the Bayesian revision for the conditional review, although framed in a different context, see Winkler (1981, 480–482).

[7] For a detailed discussion of prior distributions, calibration parameters, and an assessment of the variance-covariance matrix, along with a derivation of the information weights and variance measures in a context similar to this study, see Winkler (1981). Winkler also illustrates the generality of this model in light of the estimation of its parameters (also see Geisser 1965). The information weights, variances, etc. defining the posterior distribution can alternatively be derived (under certain restrictions) from minimization of the error variance (see Newbold and Granger 1974; Halperin 1961).

If ω_A equals one, then $E_{A|M}$ equals E_A; and similarly, the auditor's account error and variance are equal for the conditional and unconditional reviews. In this case the analysis reduces to a search for the best audit techniques for unconditional reviews. However, if ω_A is other than one or zero, then the performance of analytical review is dependent on the ω_A and ω_M values. Our analysis implicitly assumes that the weights sum to one. This is justified on the assumption that (1) auditor and manager expectations are unbiased, or (2) that any expectation bias can be removed through proper calibration of their prior probability distributions (Morris 1977; Lindley et al. 1979; DeGroot 1975). For example, if the auditor has knowledge of an understated (or overstated) book value, he or she can adjust expectations prior to the Bayesian revision. The weights (ω) need not be positive and a negative weight is theoretically possible, but a negative weight on the manager's assertion or on the auditor's expectation is unlikely in this context. Hence, an "intuitive criterion" (Clemen and Winkler 1985; Winkler 1981), or $0<\omega_A<1$ will be used to interpret some results. Similar intuitive criteria have been previously used.

Assessment Criteria

The effect of the manager's assertion is assessed by comparing the auditor's account estimate from the unconditional review with that from the conditional review on the basis of two criteria. These criteria are interrelated and common in measuring the efficiency and effectiveness of analytical review and other audit procedures.[8] The first criterion is taken from behavioral research into auditors' analytical review judgments (Kinney and Uecker 1982; Biggs and Wild 1985), and involves the accuracy of account error estimation from analytical review. This test compares the auditor's account estimate from both the conditional and unconditional reviews with the actual account value. The preference for a conditional or unconditional review is inversely related to the level of account estimation bias. The second criterion is more general and focuses on audit cost and risk consequences.

A description of the audit costs associated with the four possible outcomes of the standard accept-reject decision and the environmental conditions, Ω_0 and Ω_1, is presented in Figure 1. The expected cost (r) associated with an audit test (Υ) is:

$$r(\Upsilon)=\xi_0\cdot E(\text{Cost}\,|\,\Omega_0)+\xi_1\cdot E(\text{Cost}\,|\,\Omega_1), \qquad (3a)$$

where ξ_0 (ξ_1) is the prior probability that H_0 (H_1) is true, and $\xi_1=1-\xi_0$ (DeGroot 1975, 382). If α (β) denotes the probability of an α (β) error, then:

$$E(\text{Cost}\,|\,\Omega_0)=(AC_1)[1-\alpha(\Upsilon)]+(AC_1+AC_2)[\alpha(\Upsilon)], \text{ and} \qquad (3b)$$

$$E(\text{Cost}\,|\,\Omega_1)=(AC_1+L)[\beta(\Upsilon)]+(AC_1+AC_3)[1-\beta(\Upsilon)]. \qquad (3c)$$

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[8] The criteria imposed, and the results obtained, can only be interpreted in the context of a complete audit. Interrelations among audit tests indicate that inferences drawn from certain tests can affect the efficiency and effectiveness of the audit (e.g., nature, extent, and timing of substantive tests). Specifically, the interplay between analytical review and other phases of the audit can be viewed as depicted by Kinney (1979b, 150–152, fig. 1). Kinney views the planning of substantive tests as dependent on (among other information) the likelihood that material errors have occurred, the probability of which may be obtained from analytical review. In this case, departures from the auditor's expectation can direct attention to potential problem areas (e.g., Kinney 1979a; Knechel 1988).

Figure 1
Analytical Review Cost Matrix[1]

		Audit Environment	
		Account NOT Materially in Error $\Omega_0=\{V_T-\delta\le V_M\le V_T+\delta\}$	*Account Materially in Error* $\Omega_1=\{V_T-\delta>V_M, V_M>V_T+\delta\}$
Audit Decision	Accept H_0	AC_1	AC_1+L
	Reject H_0	AC_1+AC_2	AC_1+AC_3

[1] Factors comprising the matrix are defined as (adapted from Bailey 1981, 72):

AC_1 = "normal" audit evidence costs,
AC_2 = "unjustified" audit costs from incurring Type I (α) error (inefficiency),
L = losses associated with incurring Type II (β) error (ineffectiveness),
AC_3 = audit costs to "correct" or resolve material errors,
Ω_0 = no material error in book value, and
Ω_1 = material error in book value.

Hence, with some algebraic simplification, it can be shown that:

$$r(\Upsilon)=\xi_0\{(AC_2)[\alpha(\Upsilon)]\}+\xi_1\{(L)[\beta(\Upsilon)]+(AC_3)[1-\beta(\Upsilon)]\}+AC_1. \tag{3d}$$

Thus, according to the second criterion, the preference for a conditional or unconditional review is based on the relative minimization of audit costs $r(\Upsilon)$.

The effects from different levels of calibration for the above two criteria are also examined. Calibration reflects auditor's ability to provide accurate subjective estimates of decision parameters ($\sigma_A^2, \sigma_M^2, \rho$). For example, consider that audit risk depends upon the information weights (ω_A and ω_M), which in turn depend upon the auditor's uncertainty regarding the account estimation error (σ_A^2) and the error inherent in the manager's assertion (σ_M^2) as well as their correlation (ρ). Since these decision parameters are not objectively known, the accuracy of the auditor's subjective assessments can affect audit risk. The correspondence between the auditor's subjective assessments and the actual values is referred to as calibration. The sensitivity of the results to varying degrees of calibration is examined in a manner consistent with that taken by Beck et al. (1985).

II. Strategic Considerations for Unaudited Account Values

General Model Results

Assume that the probability assessment and hypothesis testing procedures are conducted for a hypothetical account. Similar inferences may be drawn assuming procedures are repeated for a sequence of identical trials where the auditor's loss function is the same. These assumptions are consistent with traditional definitions of inferential risks (risks of incorrect rejection and acceptance), and

Figure 2
Analytical Review Case Scenarios[1]

	Manager NOT Materially in Error $E_M=V_T$		*Manager Materially in Error* $E_M=V_T+\lambda$	
	NO Auditor Error $E_A=V_T$	*Auditor Error* $E_A=V_T+\gamma$	*NO Auditor Error* $E_A=V_T$	*Auditor Error* $E_A=V_T+\gamma$
Unconditional Review $\omega_M=0$	*C*1	*C*3	*C*5	*C*7
Conditional Review $\omega_M\neq0$	*C*2	*C*4	*C*6	*C*8

[1] Premised on the presence, or absence thereof, of manager error in book value, one can identify the type of risk to which the auditor is exposed. Specifically, in cases *C*1–*C*4 the auditor is exposed to type I risk (but no type II risk), whereas for cases *C*5–*C*8 the auditor is exposed to type II risk (but no type I risk). Note that any error is assumed material, i.e., $\{|\lambda|,|\gamma|>\delta\}$.

with prior research (Beck et al. 1985). In this section the effects of valuation errors are computed for (1) the account value estimate, and (2) audit cost and risk consequences of the unconditional and conditional analytical reviews. These effects are described in a general model, while remaining sections provide detailed analyses conditional on the audit environment. Separate case analyses are required because audit efficiency and effectiveness depend jointly on the audit decision and whether manager's book value contains intolerable error.

Accuracy of the auditor's account estimate (first criterion) from the unconditional analytical review depends on the error (γ) in the auditor's prior probability distribution, i.e., $E_A=V_T+\gamma$. For the conditional review, accuracy of the auditor's account estimate depends jointly on the errors in the auditor's and manager's (λ) pre-posterior account value estimates (see eq. [1]), i.e., $E_{A|M}=V_T+\omega_A\gamma+\omega_M\lambda$. These relations indicate that both reviews are subject to expectation error.

The audit cost consequences (second criterion) associated with each review can also be identified. The audit costs for the unconditional analytical review are:

$$\xi_0\{(AC_2)[\alpha_A(T)]\}+\xi_1\{(L)[\beta_A(T)]+(AC_3)[1-\beta_A(T)]\}+AC_1, \tag{4a}$$

whereas for the conditional analytical review these costs are:

$$\xi_0\{(AC_2)[\alpha_{A|M}(T)]\}+\xi_1\{(L)[\beta_{A|M}(T)]+(AC_3)[1-\beta_{A|M}(T)]\}+AC_1. \tag{4b}$$

Scenario I: Book Value Within Tolerable Error

A basic premise underlying Scenario I, encompassing cases *C*1 through *C*4 in Figure 2, is the absence of intolerable error in book value for the account under review. The cases are split between those for which the auditor's account value estimate is not in error (*C*1 and *C*2) and those for which it is not within tolerable error (*C*3 and *C*4). From the perspective of audit risk, cases *C*1–*C*4 are subject to type I error. The analysis proceeds by comparing the performance of the conditional review to the unconditional review (i.e., $C2$ vs. $C1$ and $C4$ vs. $C3$).

Auditor's account value estimate within tolerable error. The existence of both an auditor account estimate and a book value within tolerable error characterize the audit environment in cases $C1$ and $C2$. Under these conditions the auditor's account estimate for both the unconditional ($C1$) and conditional ($C2$) review is without error. However, a comparative analysis of audit costs across the reviews in $C1$ and $C2$ yields differences that simplify to a comparison between $\alpha_A(C1)$ and $\alpha_{A|M}(C2)$:

$$\alpha_A(C1)=Pr\{V_A>(V_T+\delta)\}+Pr\{V_A<(V_T-\delta)\}=2\cdot\Phi\left(\frac{-\delta}{\sigma_A}\right), \text{ and} \tag{5a}$$

$$\alpha_{A|M}(C2)=Pr\{V_{A|M}>(V_T+\delta)\}+Pr\{V_{A|M}<(V_T-\delta)\}=2\cdot\Phi\left(\frac{-\delta}{\sigma_{A|M}}\right), \tag{5b}$$

where $\Phi(\cdot)$ is a cumulative density function (see fn. 5). From these expressions, the difference between $\alpha_A(C1)$ and $\alpha_{A|M}(C2)$ is observed to depend on the relation between σ_A^2 and $\sigma_{A|M}^2$. Specifically, if σ_A^2 exceeds $\sigma_{A|M}^2$, then $\alpha_A(C1)$ exceeds $\alpha_{A|M}(C2)$, which suggests that $C2$ is preferred to $C1$ (i.e., conditional review preferred). Recall the auditor's error variance for the conditional review (eq. [2c]). It is clear from that expression that the conditional review's error variance ($\sigma_{A|M}^2$) is less than σ_A^2, except in the case where $\rho=\sigma_A/\sigma_M$. For the exception, the error variance of $V_{A|M}$ would be equal to that of V_A.[9] Thus, the risk of committing an efficiency error is potentially less with the conditional analytical review.

A sensitivity analysis of the audit risk effects of miscalibration in the auditor's assessment of the decision parameters ($\sigma_A^2, \sigma_M^2, \rho$) yields three primary results. First, the degree of miscalibration in any of the parameters does not affect the preference for the conditional review between $C1$ and $C2$. Second, underconfidence in the auditor's assessment of σ_A^2 and/or σ_M^2 (i.e., greater than the actual level) results in a greater predisposition to commit an efficiency error. The reverse applies in the case of overconfidence. Third, overdependence (underdependence) in the auditor's assessment of ρ increases (decreases) the predisposition to commit an efficiency error.[10]

Auditor's account value estimate intolerably in error. Cases $C3$ and $C4$ are characterized by intolerable error (no error) in the auditor's (manager's asserted) account value estimate. The auditor's account estimates from the unconditional and conditional reviews are $(V_T+\gamma)$ and $(V_T+\omega_A\gamma)$, respectively. While both reviews are subject to estimation error, the degree of error for the conditional review is dependent on the value of ω_A. In particular, if $|\omega_A|<1$, then the error is reduced, whereas the contrary is true for $|\omega_A|>1$. Applying the intuitive criterion $(0<\omega_A<1)$ yields a preference for the conditional review. Miscalibration in the auditor's decision parameters does not affect this preference. However, overconfidence in σ_M^2 and/or underconfidence in σ_A^2 results in a greater preference for the conditional review due to reduced exposure to efficiency errors. The contrary holds if there is underconfidence in σ_M^2 and/or overconfidence in σ_A^2. Miscalibration with ρ is independent of ω_A, and does not affect the error of the conditional review.

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[9] This result (posterior variance less than or equal to the prior) is based on the normality assumption for estimation errors. Most depictions of error distributions in practice approximate normality (Winkler 1981, 482; Clemen and Winkler 1985, 428). Many other distributional assumptions would yield similar behavior. However, this result is not unequivocal, for example, certain beta distributions yield a larger posterior variance (Winkler 1972, 159–160).

[10] These and many of the later inferences regarding calibration depend critically on intuitive criteria for the auditor's decision parameters (see Clemen and Winkler 1985, 430–435). In addition, while the exact direction of auditor calibration in this scenario is difficult to predict, there is some evidence of underconfidence (Solomon 1982; Tomassini et al. 1982).

Analysis of audit costs simplifies to a comparison between $\alpha_A(C3)$ and $\alpha_{A|M}(C4)$:

$$\alpha_A(C3)=1-\Phi\left(\frac{\delta-\gamma}{\sigma_A}\right)+\Phi\left(\frac{-\delta-\gamma}{\sigma_A}\right),\text{ and} \tag{6a}$$

$$\alpha_{A|M}(C4)=1-\Phi\left(\frac{\delta-\omega_A\gamma}{\sigma_{A|M}}\right)+\Phi\left(\frac{-\delta-\omega_A\gamma}{\sigma_{A|M}}\right). \tag{6b}$$

The difference between $\alpha_A(C3)$ and $\alpha_{A|M}(C4)$ is dependent on: (1) the relation between σ_A and $\sigma_{A|M}$, and (2) the value of $|\omega_A|$. Earlier it was shown that the posterior variance $\sigma_{A|M}^2$ is less than (or equal to) σ_A^2. Also notice that the intuitive criterion for ω_A shifts the domain of the cumulative function over a more dense portion of its distribution. Taken together, this indicates that $\alpha_A(C3)$ exceeds $\alpha_{A|M}(C4)$, yielding a preference for the conditional review.

The risk consequences of miscalibration do not affect the preference for the conditional review, but do affect the degree of preference. Specifically, the likelihood of efficiency errors for the conditional review is (1) reduced (increased) with overconfidence (underconfidence) in σ_M^2, (2) increased (decreased) with overconfidence (underconfidence) in σ_A^2, and (3) increased (decreased) with overdependence (underdependence) in ρ.

Scenario II: Book Value Intolerably in Error

Cases C5 through C8 in Figure 2 reflect a book value that is *not* within tolerable error in conjunction with an auditor expectation that is (and is not) within tolerable error. From the perspective of audit risk exposure, cases C5 through C8 are subject to type II error. The analysis compares the performance of the conditional review to the unconditional review (i.e., C6 vs. C5 and C8 vs. C7).

Auditor's account value estimate within tolerable error. An accurate auditor account estimate along with a book value intolerably in error comprise cases C5 and C6. Here the auditor's account estimates for the unconditional and conditional reviews are V_T and $(V_T+\omega_M\lambda)$, respectively. This finding highlights the increased likelihood of effectiveness errors with the conditional review. At a minimum, to compensate for the estimation error, additional (and probably more costly) substantive tests must be performed. This propensity to commit an effectiveness error is, however, affected by the severity and nature of the auditor's miscalibration. Specifically, overconfidence in σ_A^2 and/or underconfidence in σ_M^2 reduces the degree of auditor error (the likelihood is increased if the reverse occurs), whereas their dependence (ρ) does not affect this error.

A comparative audit cost analysis of cases C5 and C6 simplifies to a comparison between $\beta_A(C5)$ and $\beta_{A|M}(C6)$, where:

$$\beta_A(C5)=Pr\{V_M<(E_A+\delta)\}-Pr\{V_M<(E_A-\delta)\}$$

$$=\Phi\left(\frac{\delta-\lambda}{\sigma_M}\right)-\Phi\left(\frac{-\delta-\lambda}{\sigma_M}\right),\text{ and} \tag{7a}$$

$$\beta_{A|M}(C6)=Pr\{V_M<(E_{A|M}+\delta)\}-Pr\{V_M<(E_{A|M}-\delta)\}$$

$$=\Phi\left(\frac{\delta-\omega_A\lambda}{\sigma_M}\right)-\Phi\left(\frac{-\delta-\omega_A\lambda}{\sigma_M}\right). \tag{7b}$$

The difference between $\beta_A(C5)$ and $\beta_{A|M}(C6)$ is dependent on the value of ω_A. Specifically, since both risk measures' range intervals are equal (2δ), we need only identify which measure maps out a less dense portion of the distribution function for a preference ranking. Invoking the intuitive criterion $\{0<\omega_A<1\}$, the domain of the conditional review is shifted toward the dense portion of the distribution resulting in $\beta_A(C5)$ less than $\beta_{A|M}(C6)$ and, thus, the conditional review is more likely to commit an effectiveness error.

Miscalibration in the auditor's decision parameters does not affect the preference for the unconditional review. However, overconfidence in σ_A^2 and/or underconfidence in σ_M^2 reduces the auditor's propensity to commit an effectiveness error, whereas underconfidence in σ_A^2 and/or overconfidence in σ_M^2 increases this likelihood. The dependence (ρ) measure does not affect risk exposure.

Auditor's account value estimate intolerably in error. Cases C7 and C8 are characterized by error in the auditor's estimate *and* the (manager's) book value. The auditor's account estimates for the unconditional and conditional reviews are $(V_T+\gamma)$ and $(V_T+\omega_A\gamma+\omega_M\lambda)$, respectively. Both reviews are subject to expectation error. Preference between the two reviews is based on the following rule: if $\{|\omega_A\gamma+\omega_M\lambda|>|\gamma|\}$, then the unconditional review is preferred; whereas if $\{|\omega_A\gamma+\omega_M\lambda|<|\gamma|\}$, then the conditional review is preferred. To discriminate between the reviews on this rule is not straightforward in that the rule is a function of: (1) the degree of auditor and manager error, (2) the relative direction of their error, and (3) the information weights.

Utilizing the intuitive criterion for the weights, the conditional review is observed to be subject to greater expectation error (and, hence, the unconditional review is preferred) when (1) $\lambda>\gamma>0$, (2) $\lambda<\gamma<0$, (3) $\lambda<(-((1+\omega_A)/\omega_M)\gamma)<0$, or (4) $\lambda>(-((1+\omega_A)/\omega_M)\gamma)>0$. The first two situations are relatively clear. That is, provided the auditor and manager err in the same direction, the auditor is advised to not condition his or her estimate on the manager's assertion when the latter is subject to greater error. Of course, the contrary is true if the auditor suspects the manager to be relatively more accurate.[11] Conditions (3) and (4) describe a situation where the auditor and manager err in opposite directions. In this case the auditor's preference for the conditional review is inversely related to the assessed degree of manager error. The exact form of this inverse relation is determined by the information weights, which in turn are affected by σ_A^2 and σ_M^2. Specifically, underconfidence in σ_A^2 and/or overconfidence in σ_M^2 increases the preference for the unconditional review. However, overconfidence in σ_A^2 and/or underconfidence in σ_M^2 reduces this preference.

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[11] Outside of intentional error, management may provide a more accurate estimate due to superior knowledge of company operations, including its accounting system. However, in spite of this, the auditor has responsibility to detect material intentional management error, if it exists. Thus, the decision to forgo an unconditional review must include other factors such as the role of an audit and the nature of evidence.

Consideration of audit cost implications for the two reviews is contingent upon a comparison between $\beta_A(C7)$ and $\beta_{A|M}(C8)$:

$$\beta_A(C7) = \Phi\left(\frac{\delta+(\gamma-\lambda)}{\sigma_M}\right) - \Phi\left(\frac{-\delta+(\gamma-\lambda)}{\sigma_M}\right), \text{ and} \tag{8a}$$

$$\beta_{A|M}(C8) = \Phi\left(\frac{\delta+\omega_A(\gamma-\lambda)}{\sigma_M}\right) - \Phi\left(\frac{-\delta+\omega_A(\gamma-\lambda)}{\sigma_M}\right). \tag{8b}$$

The difference between $\beta_A(C7)$ and $\beta_{A|M}(C8)$ is dependent on auditor and manager error. Specifically, if the error is the same for the auditor and manager (i.e., $\gamma-\lambda=0$), then $\beta_A(C7)$ equals $\beta_{A|M}(C8)$, suggesting no preference between the unconditional or conditional review. However, if the auditor and manager errors differ, and the intuitive criterion for information weights is imposed, then the unconditional review is preferred due to less type II risk. This inference is independent of miscalibration in the auditor's decision parameters. However, underconfidence in σ_M^2 and/or overconfidence in σ_A^2 increases the effectiveness of the conditional review, but it remains less than that of the unconditional review. Similarly, overconfidence in σ_M^2 and/or underconfidence in σ_A^2 exposes the conditional review to increased type II risk. Any over- or underdependence in ρ does not affect the risk of either review.

Implications of Conditional Analytical Review

The major implications of the conditional review are categorized by audit environments and presented in Table 1. The middle two columns summarize the implications of conditional and unconditional reviews for (1) expectation bias in the auditor's account value estimate (criterion 1), and (2) audit cost/risk exposure (criterion 2). The two right-most columns describe the incremental effects from using a conditional review, relative to an unconditional review, under variations in the audit environment. It is shown that a conditional review has the potential to reduce both expectation bias and incorrect rejection risk when the unaudited book value is within tolerable error. Conversely, a conditional review increases the expectation bias and incorrect acceptance risk exposure when the book value is not within tolerable error.

III. Summary and Conclusions

The purpose of this study was to analyze the joint relation between unaudited book values and analytical review account estimation with respect to audit cost and risk consequences for a comprehensive set of audit scenarios. The risk consequences, as summarized in Table 1, depend on the auditor's decision

Table 1
Consequences of Unaudited Book Values for Analytical Review

	Auditor Criteria		Conditional Review[1]	
Audit Environment	*Expectations*	*Audit Costs/Risks*	*Expectation*	*Cost/Risk*
Scenario I. Manager Book Value Within Tolerable Error:				
A. Auditor Estimate Within Tolerable Error (Case C1 vs. Case C2)	C1 accurate C2 accurate	$\alpha_A(C1) > \alpha_{A\|M}(C2)$, if $\sigma_A > \sigma_{A\|M}$ $\alpha_A(C1) = \alpha_{A\|M}(C2)$, if $\sigma_A = \sigma_{A\|M}$	None	Less α Risk
B. Auditor Estimate Not Within Tolerable Error (Case C3 vs. Case C4)	C3 in error* C4 in error	$\alpha_A(C3) > \alpha_{A\|M}(C4)$, if $z_1 < z_2$† $\alpha_A(C3) = \alpha_{A\|M}(C4)$, if $z_1 = z_2$ $\alpha_A(C3) < \alpha_{A\|M}(C4)$, if $z_1 > z_2$	Better by $\omega_M \gamma$	Less α Risk
Scenario II. Manager Book Value Not Within Tolerable Error:				
C. Auditor Estimate Within Tolerable Error (Case C5 vs. Case C6)	C5 accurate C6 in error	$\beta_A(C5) < \beta_{A\|M}(C6)$, if $\|\omega_A\| < 1$ $\beta_A(C5) = \beta_{A\|M}(C6)$, if $\|\omega_A\| = 1$ $\beta_A(C5) > \beta_{A\|M}(C6)$, if $\|\omega_A\| > 1$	Worse by $(1-\omega_A)\lambda$	More β Risk
D. Auditor Estimate Not Within Tolerable Error (Case C7 vs. Case C8)	C7 in error‡ C8 in error	For $(\gamma-\lambda) \neq 0$: $\beta_A(C7) < \beta_{A\|M}(C8)$, if $\|\omega_A\| < 1$ $\beta_A(C7) = \beta_{A\|M}(C8)$, if $\|\omega_A\| = 1$ $\beta_A(C7) > \beta_{A\|M}(C8)$, if $\|\omega_A\| > 1$ For $(\gamma-\lambda) = 0$: $\beta_A(C7) = \beta_{A\|M}(C8)$	Worse by $\omega_M(\lambda-\gamma)$	More β Risk

[1] Incremental effects of the conditional review are computed relative to the unconditional review for expectation error and audit cost/risk. These computations are dependent on the applicability of "intuitive criteria" for audit environments B, C, and D.

* The following decision rule is applicable: C4 preferred to C3 if $|\omega_A| < 1$, C3 preferred to C4 if $|\omega_A| > 1$, indifferent otherwise.

† The z_1 and z_2 terms are defined as: $z_1 = (\delta-\gamma)/\sigma_A$, $z_2 = (\delta-\omega_A\gamma)/\sigma_{A|M}$.

‡ The following decision rule is applicable: C7 preferred if $|\omega_A\gamma+\omega_M\lambda| > |\gamma|$, C8 preferred if $|\omega_A\gamma+\omega_M\lambda| < |\gamma|$, indifferent otherwise.

parameters. These decision parameters comprise (1) the auditor's confidence in his account estimate, (2) the auditor's confidence in the (manager's) book value, and (3) the dependence between the auditor's and manager's account estimates. Support for analytical review that is, or is not, conditional on the manager's assertion is dependent on specific circumstances and assumptions that auditors are willing to make about the audit setting.

For some perspective on the practical significance of these results, along with some insight on how an auditor may exploit these findings with regard to book value, it is useful to consider audit practice. Shields et al. (1988, 2) argue that "because unaudited book values and audit values are highly correlated, . . . use of the former when estimating the latter may be an efficient and effective means by which to accomplish this task." Our results provide some substance to this statement only under the scenario in which book value is within tolerable error. However, what is not obvious is how the auditor *ex ante* obtains knowledge that book value is within tolerable error. Shields et al. suggests that the auditor use information on the strength of internal controls along with whether prior years' book values contained intolerable error. The danger in this suggestion rests with the circularity of reliance on book value itself as audit evidence for the acceptability of book value, and the violation of the purported role of auditing. First, audit evidence is presumably gathered to assess *whether* there is intolerable error in book value, and not to assess whether book value can be used to revise probability assessments of value. Second, a conditional analytical review would seem to violate the fundamental role of an audit. For example, Bailey (1981, 58) argues that if the manager's "assertions could be accepted as true—or at least as not materially in error—without auditor action, there would be no economic justification for auditor fees." In the extreme, conditions that yield a preference for a conditional review, beg for a method that *ex ante* predicts when an audit is unnecessary. Third, auditing standards (e.g., SAS Nos. 16 and 31) encourage the auditor to search for errors and irregularities in book values, and requires that he or she obtain *independent* evidential matter. The manager's book value does not appear to meet this independence criterion. Therefore, Heintz and White's (1989, 37) suggestion that the Auditing Standards Board consider the circumstances under which book values can be used in analytical review appears to be unnecessary.

This conclusion is consistent with the concerns that motivated the Kinney and Uecker (1982) and Biggs and Wild (1985) studies. While these studies did not explicitly state that the unaudited book value contained intolerable error, Kinney and Uecker's argument that "the only inappropriate information is the book value(s)" (p. 67) for analytical review is consistent with the arguments above and the findings in this paper. Our results also provide substantive meaning to the expressed concerns of Biggs and Wild "that protecting against beta risk is the major concern" (p. 611). Thus, if auditors rely on book value, and they are not accurate in their assessments of no intolerable error in book value, then they unnecessarily expose themselves to increased risk of incorrect acceptance and audit costs. Furthermore, the practical significance of explicitly incorporating the unaudited book value in the auditor's account value estimation procedure appears minimal. That is, reliance on the unaudited book value would seem to require a procedure that, if reliable, would preclude the need for analytical review (or any other audit procedures).

The results are also consistent with, and provide motivation to, prior studies directed at developing improved analytical review methods for predicting audit values (Kinney 1978, 1979b; Lev 1980).[12] Selection among analytical review methods is a function of the assessed risk exposure. To the extent that an analytical review method yields more accurate and more confident estimates, audit risk exposure is reduced.

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[12] The type of model used by the auditor to obtain an account expectation does not directly affect any of the inferences. However, a heuristic model may mask the auditor's dependence on book value (if present), while a traditional statistical model (e.g., regression) would make this dependence explicit.

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SMALL SAMPLE STUDIES

M. Edgar Barrett, Editor

On Assessing a Firm's Cash Generating Ability

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ABSTRACT: Focusing on funds flow from operations, a way for analysts to use financial statement information to obtain additional insights when assessing a firm's cash generating ability is proposed. The method provides a clearer focus on a firm's cash generating ability from operations. Results from applying the proposed method are compared with information from traditional funds flow statements (APBO No. 19 and SFAS No. 95) for 20 firms, highlighting the incremental insights available.

THIS paper proposes a way for analysts to use currently disclosed accounting information to obtain additional insights in assessing a firm's cash generating ability.[1] The method involves identifying and classifying cash flows such that the various effects and implications of a firm's operating and financing activities can be measured and understood. The differences between the information available from applying this method and that from applying APBO No. 19 and SFAS No. 95 are illustrated using data from the fiscal 1982 financial statements of The Limited, Inc.[2] Results of applying the method are then compared with information available from traditional funds flow statements for 20 firms over the period 1980–1984.[3]

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There is a significant and growing body of literature concerning both the disclosure and the use of funds flow information. One group of authors has noted inconsistency in how firms classify certain events as operating or nonoperating (such as interest revenue and expenses, sales of long-term assets, and early debt extinguishments) between the income statement and the funds flow statement (Ketz and Largay 1987; Nurnberg 1972).

Other authors have focused on the best indicator of a firm's financial state. Rappaport (1979) proposed the concept of "distributable funds," the periodic amount said to be available for distribution to stockholders. Hunt (1975, 1979) proposed the concept of "funds position," which focused on the difference between the amount of internally generated operating funds in a period and the amount of funds devoted to capital investment in that same period. According to Hunt, a series of negative "funds positions" indicates fundamental problems in a firm's operations and investment policies. A similar approach is Hawkins' (1986, 127–129) "total cash flow analysis."

We expand Hunt's concept by distinguishing between "capital maintenance" investments and "capital expansion" investments. Different assessments of a firm's cash generating ability are thus made available. For example, growing firms and firms not replacing capital would receive different assessments under Hunt's concept and this proposal. Additional information about cash generating ability is also obtainable from the application of this proposal via the inclusion of the concepts of dispensable, distributable, and discretionary funds as well as from several additional refinements. While the underlying concept of "distributable funds" has the same definition as Rappaport, the determination of the amount differs.

A Focus on Funds Flows From Operating Activities

The principal focus of financial analysis is on the amount of funds generated from operating activities.[4] The focus assumes that the assessment of a firm's cash generating ability from operations should not be influenced by financing activities. This flows from the fact that financial leverage allocates funds flow, changes resulting from it do not reflect changes in cash generating ability. Fur-

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[1] Until recently, much of the information was provided by the Statement of Changes in Financial Position prepared under the requirements of Accounting Principles Board Opinion (APBO) No. 19, *Reporting Changes in Financial Position* (AICPA 1971). Currently, much of that information is provided by the Statement of Cash Flows prepared under the requirements of SFAS No. 95, *Statement of Cash Flows* (FASB 1987b).

[2] The insights available from applying this method are both similar to and distinct from those that may be obtained using the data now available in a Statement of Cash Flows prepared in accordance with SFAS No. 95.

[3] These statements have had a variety of titles over the years (see fn. 1 above). For purposes of clarity and simplicity the term "funds flow statement" will be used here.

[4] Dorfman (1987, 37) reports in *The Wall Street Journal*, "Follow the money. That's a guiding principle for the increasing number of stock analysts and investors who study corporate cash flows. While none of them advocates using cash flow analysis by itself, they say it can be an important tool in piercing the camouflage that sometimes makes reported earnings misleading." Bankers also desire and like the funds flow statement (see Stephens 1980; Abdel-khalik et al. 1983).

ther, the cash generating process for operations—which requires one type of managerial decisions and reflects operating risk—is different from the cash generating process for financing activities, which requires another type of managerial decisions and reflects financial risk. An analysis of operating funds flows should also provide insight into the ability of the firm and its management to generate these flows in the future.[5]

The important questions, therefore, are: (1) how should funds flows from operating activities be distinguished from funds flows from other activities? and, (2) how should funds flow from operating activities be determined. Each of these questions will be discussed separately below.

Separation of Operating Activities from Financing Activities

Financial leverage should not influence an assessment of operating funds flow since the presence of such leverage affects only the allocation of funds flow between creditors and investors. Its presence does not indicate a change in cash generating ability. An analysis of firms' cash generating ability prior to considering any allocation of the funds flow—even though there may be different requirements for making specific payments—is important even if financial leverage changes as it might under a leveraged buyout.

Only two types of a firm's activities, operating and financing, need be separated for purposes of funds flow analysis. Investment activities need not be shown as a separate activity.[6] Such an elimination is rooted in the premise that investments are undertaken either: (1) to earn a return from providing goods and services (the purchasing, producing, and selling operations), or (2) to earn a return from nonoperating (financial) assets. The first category of investing activities is undertaken to generate operating funds flows. The second category is undertaken to generate financing funds flows.

Separating activities into operating and financial categories leads to another difference from current practice. Currently available funds flow statements do not fully separate operating activities from financing activities since financial revenues (such as interest revenue and investment income) and financial expenses (such as interest expense) are included in the current calculation of funds from operations under SFAS No. 95. The effects of operating activities need to be completely separated from financing activities.[7,8]

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[5] The focus on the future is consistent with the user orientation in accounting which states that the purpose of accounting is to provide information for estimating future cash flows (AICPA 1973a; FASB 1980, 1981, 1986a; Elliott 1986).

[6] The stated objective of APBO No. 19 was to summarize the financing and investing activities of firms, including the extent to which a firm has generated funds from operations during a period, and to provide complete disclosure of changes in financial position. SFAS No. 95 clearly provides for this in its formatted disclosures.

[7] Accounts receivable and accounts payable are financial instruments arising from operations. We classify these items as affecting the operating cash flows to conform to current practice. Analysts will have to decide whether major changes in these items reflect changes in operations or changes in methods of financing business operations.

[8] The ability to analyze a firm's cash generating ability prior to considering the effect of the firm's financing activities has become even more important with the required consolidation of finance subsidiaries (SFAS No. 94, FASB 1987a).

Capital Maintenance Considerations and Operating Activities

There is an inseparable relation between a firm's future ability to generate funds from operating activities and its current need to make investments to maintain itself as a going concern. The latter need is sometimes referred to as "capital maintenance" (that is, a level of current investment is required in order to enable a firm to maintain operating capacity). In other words, not all investments in operating assets are equivalent. A level of operating investment is required to maintain the operating capacity and this amount should be separated from other funds flow uses. Any remainder of the operating investment is made either to increase the operating capacity of existing business or to invest in new types of businesses.

This distinction is important to an understanding of a firm's funds flows. Expansion of the current business or entry into new types of businesses can be undertaken using new debt or equity financing. Unlike capital maintenance investments, such investments need not be able to be funded from current operating funds flow in order for the firm to avoid a real terms reduction of the per share value of owners equity.

The Basic Data Implementation

Reorganizing the items reported on the funds flow statement is all that is necessary for implementing the parts of the proposal discussed so far. The following revisions to traditional funds flow statements provide for a separation of operating from financing activities and allow the user to focus on assessing the ability of a firm to generate operating funds flows in the future:

1. Add (subtract) interest expense (income) to income from continuing operations and treating it as a subtraction (addition) under financing activities. This is done in order to separate the cost of (return from) financing from the cost of (return from) operations.
2. Adjust revenues and expenses for collections from customers and payments to suppliers, in order to reflect cash receipts and expenditures.
3. Classify as operating funds flow the funds used to maintain the real level of operating assets (such as inventory and property, plant, and equipment).
4. Separate those investments in operating assets which are not required for "capital maintenance."
5. Separate financing activities into debt and equity components.

The first revision may be used to generate what is termed "Gross Funds from Operations." The second adjusts accrual basis income to reflect cash receipts from customers and cash payments to suppliers.[9] The third change allows for the generation of "Net Funds from Operations before Expansion," while the fourth change provides a subtotal that might be called "Net Funds from Operations"—that is, it reflects the separation of "steady state" from "growth" investments. The final alteration can be used to show burdens of financing, and extensions and receipts from financing by type of financing. This separation is especially important when net funds from operations are negative because of the differing "requirements" for paying the burden of debt and the burden of equity.[10]

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[9] This adjustment is unnecessary for statements of cash flows prepared under the direct method of SFAS No. 95. The information is available on the face of the financial statements.

The effect of income taxes on the segregated disclosures also needs to be considered. Following Nurnberg (1983) and intraperiod tax allocation in APBO No. 30, we use the concept that taxes follow the transaction; that is, income taxes will be allocated to individual transactions as operating and financing activities are separated on the funds flow statement. Thus, adjustments of income will use after tax amounts at the marginal tax rate for the individual transaction.[11]

Dispensable, Distributable, and Discretionary Funds Flows

The revisions just outlined may provide three additional items of information. These new items are: (1) dispensable funds generated; (2) distributable funds generated; and (3) discretionary funds generated. The amount shown as *dispensable funds generated* provides information about the "self financing" ability of the firm. A positive number indicates that enough funds have been generated by operations to cover the investments required to maintain "steady state" operations. The amount shown represents either the amount of funds generated from operations which a firm can use for financing activities or the amount that it must make up from financing activities. When there are no debt requirements, it represents the amount available for dividends without any element of liquidation. If the firm has debt and the dispensable funds number is negative, the firm must still pay interest, and by implication, the firm had to borrow to pay interest.

The amount of *distributable funds generated* provides an indication of the ability of a firm to maintain itself given its current financial leverage. It provides information about the joint effects of operating and leveraging characteristics. A positive number indicates that enough funds have been generated by operations to cover the required interest on current debt in addition to meeting investments to maintain "steady state" operations. A negative number accompanied by cash dividends implies that the firm had to borrow to pay dividends, thus, resulting in a partial liquidation of the firm.

The *discretionary funds generated* indicates the funds available after both maintaining "steady state" operations and covering interest and dividends. A positive number indicates that the firm has available funds for growth or other activities such as stock repurchase or debt reduction.

Refinements

There are other items that affect an analyst's ability to estimate both a firm's future funds flow and their uncertainty. Among the more prominent are: "one shot" effects; peripheral and incidental operating activities; and information about financing activities.

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[10] The funds flow burden of debt financing consists of the after tax cost of interest. A firm must pay this amount to avoid financial complications, including bankruptcy. Our concern is whether this amount is being generated by operations after coverage of "steady state" investment. The funds flow burden of equity financing consists of cash dividends. While no legal requirements may exist for paying dividends, an economic requirement may exist (Dielman and Oppenheimer 1984; Watts 1973).

[11] The marginal rates used are the maximum rates for income tax purposes unless the adjustment carries specific income tax effects.

Sustainable Funds Generation

There is a need to differentiate between sustainable funds generating activities—activities which are expected to continue to generate funds in future periods—and "one shot" funds generations from operations. APBO No. 30 requires firms to separate extraordinary items, discontinued operations and the cumulative effect of accounting changes from income from continuing operations on the income statement and that these items should also be shown separately on the funds flow statement.[12] There are two different issues: (1) the separation of these items into operating and financing activities, and (2) the handling of "one shot" operating funds flow.

Extraordinary items may be either one-time effects on operating activities (e.g., an extraordinary gain resulting from the receipt of insurance from a fire loss) or on financing activities (e.g., an extraordinary gain resulting from the redemption of debt). Funds generated by operations should be adjusted for each of these items. Those items classified as financing activities also should be removed from the operations section and placed under the appropriate financing activity (debt or equity). By definition, discontinued operations would always be an operating activity. The funds flow effects of gains and losses from discontinued operations should be shown after net funds from continuing operations. Since the cumulative effect of accounting changes is normally an income item not requiring the use of funds, this item has already been removed from funds generated from operations under present disclosure rules. Thus, no further adjustment is necessary.

Operating related "one shot" effects can be handled by using income from continuing operations as the starting point and moving the after tax effect of all "one shot" operating earnings items to yield a new category, "net funds from *continuing* operations before expansion." Effecting this change also allows one to properly show dispensable, distributable, and discretionary funds by deleting any "one shot" funds flow items from their calculation. As the primary rationale behind analyzing the funds flow statement is to assess future cash generating ability, "one shot" funds flows need to be shown separately since they provide little guidance in respect to the prediction of future cash flows. Thus, dispensable funds is defined as net funds from continuing operations (before expansion), and distributable funds and discretionary funds would be this amount less the appropriate burdens.

Separation of Peripheral and Incidental Operating Activities

Beyond the "one shot" effects, so called peripheral and incidental operating activities may have different risks (different distributions of future funds flow) than will the central operating activities. In other words, the funds flow from central operating activities may be more or less likely to be different in the future than will funds from incidental and/or peripheral operating activities. The separation of central operating activities from peripheral and incidental activities involves the activities by which firms generated funds and the disclosure of these activities. For instance, gains and losses on the sale of marketable securities should be seen as incidental to a firm's main activities, unless it is a financial institution (Ketz and Largay 1987, 13).

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[12] The purpose of APBO No. 30 (AICPA 1973b) was to further implement the "all inclusive income statement concept" by prohibiting charges to retained earnings. The separation of "one shot earnings" from an amount termed herein as income from continuing operations, was felt to be needed in order to allow an analyst to project future amounts of sustainable net income.

The separation of peripheral and incidental operating activities from a firm's central operating activities may be especially difficult for diversified firms. The analyst will have to determine in these situations if some segments are core activities and other segments are separable. Peripheral and incidental operating activities will have no meaning for conglomerates. For other firms, some segments may be related around such things as a common technology, a common customer base, or common distribution channels.

Separate disclosures are also desirable when different levels of perceived riskiness exist between different funds flow streams. From a financial analysis standpoint, this would result in two parts of the funds from operations: (1) funds generated by central operating activities, and (2) funds generated by peripheral and incidental activities.

An Example: The Limited, Inc.

Funds Flow Under APBO No. 19

The funds flow statement of The Limited, Inc., as reported in their 1982 fiscal year Report to Stockholders and prepared under APBO No. 19, is shown in Exhibit 1. This statement used the "Cash and Equivalents" definition of funds.[13] That is, the statement showed the items that caused an increase or decrease in the amount of cash and equivalents available to The Limited. Exhibit 1 shows The Limited reported a decrease of $5,837,000 in cash and short-term investments during the fiscal year ended January 29, 1983.

Formats for the funds flow statement, acceptable under APBO No. 19, showed funds from operations obtained as an adjustment to net income for expenses not requiring the expenditures of funds. In Exhibit 1, these are the adjustments shown to "net income" for "depreciation and amortization" and for "deferred income taxes and other" in order to reach an amount for "working capital from operations." This illustrates three points: (1) there was no usual classificatory separation of operating, investing, and financing activities within specific financial reports prepared under APBO No 19; (2) the distinction between operations, investing, and financing activities was not always handled in a similar fashion across firms (note that The Limited, by placing the adjustment for working capital prior to summing to an amount for funds provided by operations, was

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[13] The definition of funds for a funds flow statement was irrelevant to the preparation of a statement under APBO No. 19. The definition affected only what items would be included on the statement. A funds flow statement could have been prepared for any balance sheet items (Clemente 1982). SFAS No. 95 adopted either cash or cash equivalents as the definition of funds.

Exhibit 1

The Limited, Inc. & Subsidiaries

Consolidated Statement of Changes in Financial Position*
Year Ended January 29, 1983
(thousands)

Cash was provided from:	
Operations	
Net income	$ 33,592
Add expenses not requiring working capital	
Depreciation and amortization	22,509
Deferred income taxes and other	10,322
Working capital from operations	$ 66,423
Cash flow additions (requirements) resulting from (includes acquired subsidiaries since acquisition dates in 1982)	
Inventories	$ 7,005
Payables	(22,607)
Income taxes	8,775
Other current assets and liabilities	(7,416)
Cash provided from operations	$ 52,180
Sale of receivables to Limited Credit Corp., net of equity investment	47,947
Long-term debt incurred to acquire subsidiaries	110,439
Cash balances of acquired subsidiaries at dates of acquisition	14,304
Total cash provided	$224,870
Cash was used for:	
Purchase of net assets of acquired subsidiaries	$111,452
Investment in property and equipment	35,506
Reduction of long-term debt, net of $7,104,000 conversion of debentures in 1982	80,130
Cash dividends and other, net	3,619
Total cash used	$230,707
Increase (decrease) in Cash and Equivalents	(5,837)
Cash and Equivalents, beginning of year	11,326
Cash and Equivalents, end of year	$ 5,489

* Source: 1982 Annual Report

terming changes in current assets and current liability items except cash and equivalents as operational items); and (3) since no specific format was required by GAAP, The Limited could present the funds flow statement as it desired.

The APBO No. 19 funds flow statement format provided an amount termed funds generated from operations ($52,180,000 for The Limited). After this amount, the funds flow statement showed: (1) financing and investing activities that affected funds flow, and (2) other significant financing and investing activities (that is, activities that did not directly result in funds flow, such as the purchase of investments by stock issuance).

Exhibit 2
The Limited, Inc.
Estimated Statement of Cash Flows[1]
(Prepared under SFAS No. 95)
Year Ended January 29, 1983

Operating Activities	
Net Income	$ 33,592
Add expenses not requiring cash:	
Depreciation and amortization	22,509
Deferred income taxes and other	10,322
Changes in accounts:	
Receivables	47,947
Inventory	7,005
Payables	(22,607)
Income taxes	8,775
Other current accounts	(7,416)
Total from operating activities	$100,127
Investing Activities	
Purchase of plant and equipment	$ (35,506)
Purchase of new subsidiaries, net of cash received	13,291
Total from investing activities	$ (22,215)
Financing Activities	
Financing from long-term debt	$ (80,130)
Cash dividends	(3,619)
Total from financing activities	$ (83,749)
Decrease in cash and equivalents	$ (5,837)

Schedule of Noncash Investing and Financing Activities

Purchase of subsidiaries through issuance of long-term debt	$110,439

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[1] Presumes, based upon information in the report to stockholders, that all items affected cash. Note that some long-term debt and investments in property and equipment may have been capital leases and, thus, may not be shown within the appropriate section of this particular statement of cash flows.

Funds Flow Under SFAS No. 95

A funds flow statement using the guidelines of SFAS No. 95 for The Limited, Inc. prepared by the authors based upon the information in the fiscal 1982 Report to Stockholders is shown in Exhibit 2. SFAS No. 95 established specific criteria for separating operating, investing, and financing activities on the statement of cash flows. It overcame two format shortcomings of APBO No. 19 through separating by type of activities and presenting noncash investing and financing activities in a separate statement. Exhibit 2 shows that The Limited reported a decrease of $5,837,000 in cash and short-term investments during the fiscal year, the same as under APBO No. 19. The Exhibit 2 Statement of Cash

Flows also provides an amount termed cash (funds) generated from operations ($100,127,000), that is significantly different from the amount shown for cash provided from operations in Exhibit 1.

A Revised Funds Flow Statement

The fiscal 1982 funds flow statement of The Limited, Inc., as revised to illustrate the method proposed in this paper, is shown in Exhibit 3. Among other things, the amount of investments in productive assets for "capital maintenance" has to be estimated by the analyst. This estimate of capital maintenance can be made using additional information contained in the firm's financial statements—such as the expenditure to acquire additional stores shown in Exhibit 3. The estimate can also be made using information accompanying the financial statements such as the liquidity and capital expenditures information in the Management Discussion and Analysis section.[14] Finally, the estimate can be made using generalized techniques for estimating the effects of cost changes such as general price level or specific price level adjustments. The use of replacement cost disclosures, previously required by SFAS No. 33 (FASB 1979), is illustrated later in making the comparative analysis for 20 firms.

Exhibit 3 shows the fiscal 1982 funds flow statement of The Limited, Inc. adjusted for the changes discussed above to: (1) separate operating activities from financing activities, and (2) to separate "steady state" investments from growth. This Exhibit shows *Gross Funds from Operations* of $98,111,000 after separating operating activities from financing activities, *Net Funds from Operations Before Expansion* of $69,610,000, and *Net Funds From Operations* of ($27,538,000) after separating steady state operating investments from growth operating investments.[15]

Comparative Analyses

If the proposed funds flow statement analysis has incremental benefit, it should be able to identify firms with fundamental funds flow problems when such problems could not be easily detected from traditional funds flow statements. Funds flow data for 20 firms were collected and analyzed to compare the

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[14] A substantial amount of information is required for publicly reporting firms under Regulation S-K that can prove useful for making such estimates, especially the requirements for discussing future investment needs under Item 303, Management Discussion and Analysis (17 Code Federal Regulations 229, 303).

[15] The Limited made major expansion during 1982. Note that if capital expansion was not considered and the first approximation—that all investments in inventory and fixed assets constituted capital maintenance—was used, the "net funds generated before expansion" (dispensable funds generated) would be a negative ($27,538,000), indicating a severe cash flow problem for The Limited. However, when the "steady state" investments are separated from the "growth" investments, the dispensable funds generated are a positive $69,610,000, indicating a very healthy firm from an operating cash flow standpoint. We have further assumed for The Limited that all investments in plant and equipment are for capital maintenance and all investments in acquisitions of other companies are for capital expansion. A more sophisticated analysis would involve examination of investments in plant and equipment ($35,506,000) to further separate maintenance and growth investments included in this amount. Otherwise, potential for bias exists where firms that spend money on internal growth might look worse than firms that expand through acquisitions.

Exhibit 3

The Limited, Inc.
Illustrative Reformatted Funds Flow Statement
Year Ended January 29, 1983
(thousands)

Net Income	$ 33,592
Add expenses not requiring funds:	
Depreciation and amortization	22,509
Deferred income taxes and other	10,322
Add: Revenues of prior period collected	47,947
Subtract: Payments of prior period expenses	(22,607)
Add: Interest burden (net of taxes)	6,348[1]
GROSS FUNDS FROM OPERATIONS	$ 98,111
Investments:	
Inventories	7,005
Property and Equipment	(35,506)
NET FUNDS FROM OPERATIONS BEFORE EXPANSION	$ 69,610[2]
Purchase of new subsidiaries	(97,148)
NET FUNDS FROM OPERATIONS	$(27,538)
Financing—Debt:	
Long-term debt	30,309
Income taxes	8,775
Other current accounts	(7,416)
Interest Burden	(6,348)
FUNDS PROVIDED (USED) BY DEBT FINANCING	$ 25,320
Financing—Equity:	
Dividends	$ (3,619)
FUNDS PROVIDED (USED) BY EQUITY FINANCING	$ (3,619)
NET FUNDS PROVIDED BY FINANCING	$ 21,701
INCREASE (DECREASE) IN CASH	$ (5,837)
Additional Information	
DISPENSABLE FUNDS GENERATED[3]	$ 69,610
Less Burden of Debt (interest)	(6,348)
DISTRIBUTABLE FUNDS GENERATED[4]	$ 63,262
Less Burden of Equity (dividends)	(3,619)
DISCRETIONARY FUNDS GENERATED[5]	$ 59,643

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[1] After tax interest cost from 1982 annual report.

[2] May be understated as it presumes all investments in (1) inventory, and (2) property, plant, and equipment are "steady state" except for purchase of new subsidiaries.

[3] This amount is equal to Net Funds From Operations Before Expansion.

[4] This is the amount available for stockholders.

[5] This is the amount available for real growth.

funds flow amounts under APBO No. 19 and SFAS No. 95 with funds flow amounts under the proposals discussed in this paper. The 20 firms were chosen because each was operating in an industry (such as auto, steel, tires, or paper) generally believed to be having financial difficulties. Thus, the analysis should reveal whether these specific firms were having fundamental funds flow problems and, if so, provide some indication of the magnitude of these problems. The results of the analysis are shown in Table 1.

Five years of data were used for the comparative analysis in order to provide a reasonably long time frame. For the period 1980 to 1984, only two of the 20 firms (American Can and International Harvester) showed negative funds from continuing operations in the funds flow statements included in their annual reports. As can be seen from the first column in Table 1, the majority of the firms reported huge positive funds from operations, seeming to indicate very healthy funds flow positions. The results were not much different when the operating funds flow were recast to a SFAS No. 95 cash-type basis (col. 3). For the period 1980 to 1984 only International Harvester showed negative funds flow from continuing operations under this basis.

A dramatically different conclusion emerges when the funds flow statements were recast based upon the proposals in this paper. Using "steady state" approximations for necessary investment in inventories and fixed assets obtained from SFAS No. 33 replacement cost disclosures in the annual reports, dispensable, distributable, and discretionary funds flow for the five-year period 1980 to 1984 were calculated. The approximations involved: (1) the difference between replacement cost of goods sold and historical cost of goods sold as the necessary "steady state" operating investment in inventory, and (2) replacement depreciation as the necessary "steady state" operating investment in property, plant, and equipment.

Seventeen of the 20 firms showed negative dispensable funds flow for the five-year period (col. 4 of Table 1). These 17 firms were not generating sufficient funds from operations to cover "steady state" investments required to maintain the operating capacity of existing businesses. Nineteen of the firms showed negative distributable funds flow for the five-year period (col. 5). These 19 firms were not generating sufficient funds from operations to cover "steady state" investments and pay interest; for 17, it indicates that if steady state investments were covered, then they had to borrow to pay interest. All 20 firms showed substantial negative discretionary funds flows for the five-year period (col. 6). Since each of these firms paid dividends, by implication, they had to borrow to pay dividends! Further, the adjusted funds flow statements of no firm indicated the ability to provide funds from current businesses for growth. These conclusions confirm that individual firms in industries such as autos, tires, steel, and paper faced significant funds flows difficulties in modernizing their plant facilities during this period.

Conclusion

Proper classification, definition, and presentation of funds flow is important if investors and creditors are to gain the maximum analytical insight from funds flow statements. To aid analysts, several proposals to provide insights in addition

Table 1
Comparative Analysis of Funds From Operations Fiscal Years 1980–1984 (all amounts in millions)

Company	*Funds from Operations per Annual Report*[1]	*Basis*[2]	*Funds from Operations Adjusted to Cash-Type Basis Before Investments*[3]	*Dispensable Funds Flow*[4]	*Distributable Funds Flow*[5]	*Discretionary Funds Flow*[6]
American Can	(34.1)	C&MS	730.4	(405.9)	(543.6)	(890.1)
Bethlehem Steel	1,031.6	C&MS	1,293.7	(5,711.6)	(5,942.5)	(6,193.5)
B. F. Goodrich	786.0	C&MS	753.9	(1,100.2)	(1,327.2)	(1,504.3)
Crown Zellerbach	985.2	C&ST	897.1	(135.3)	(255.9)	(545.8)
Eastern Gas & Fuel	552.4	C&CE	570.4	27.3	(85.3)	(216.8)
Ford Motors	16,445.1	C&MS	16,457.1	(629.8)	(2,067.3)	(2,984.4)
General Motors	31,784.7	C&MS	29,681.6	(4,024.3)	(6,884.3)	(11,655.0)
Georgia-Pacific[7]	2,313.0	C	2,448.0	228.7	(165.0)	(708.0)
Goodyear	3,010.8	C&ST	3,144.1	(1,190.6)	(1,693.4)	(2,120.5)
Interlake	289.6	C	264.7	(488.4)	(517.0)	(590.2)
International Harvester	(514.9)	C&MS	(1,204.9)	(2,469.5)	(3,253.7)	(3,367.7)
International Paper[8]	2,864.1	C&TI	2,867.2	530.8	349.5	(365.2)
Kaiser Aluminum	608.6	WC	371.9	(2,174.7)	(2,461.6)	(2,667.8)
Lukens	108.9	C&ST	114.0	(226.4)	(247.0)	(261.7)
National Can	455.0	WC	415.9	(51.0)	(132.2)	(186.2)
National Steel	411.0	C&ST	483.7	(2,454.0)	(2,614.8)	(2,760.8)
Owens Illinois	1,685.5	NLF	1,752.9	(896.0)	(1,082.5)	(1,319.2)
Reynolds Metals	750.4	C	830.6	(3,750.6)	(3,983.4)	(4,156.7)
U.S. Steel	5,109.0	C&MS	4,750.0	(10,921.2)	(12,725.0)	(13,643.0)
Weyerhauser	3,307.0	C&ST	3,336.7	(194.6)	(522.2)	(1,481.2)

[1] The funds flow from continuing operations shown on the corporation's annual reports for the period 1980–1984 ("one-shot" earnings (losses) eliminated) adjusted to the basis used for reporting in 1984.

[2] The basis in preparing the funds flow statement by the company in 1984. The codings are: C&MS=Cash and Marketable Securities; C&ST=Cash and Short-Term Investments; C&CE=Cash and Cash Equivalents; C=Cash; C&TI=Cash and Temporary Investments; WC=Working Capital; and NLF=Net Liquid Funds.

Table 1—*Continued*

[3] This column shows the "Funds from Operations per Annual Report" adjusted as necessary (1) to provide a cash-type basis (the 1984 annual report basis except for Working Capital and Net Liquid Fund bases which are adjusted to cash), and (2) to provide an amount prior to any operating investments in inventory and property, plant, and equipment. Within the limits of the data in the Statement of Changes in Financial Position, this approximates the amount that would be reported as cash from operating activities in the Statement of Cash Flows prepared under SFAS No. 95.

[4] Amounts in "Funds from operations adjusted to cash-type basis before investments" adjusted (1) for leverage by adding the after tax interest expense for the period 1980–1984, and (2) for required investments in inventories and fixed assets by subtracting the replacement cost approximations for the period 1980–1984.

[5] Amounts in "Dispensable Funds Flow" less the burden of debt (the after tax interest expense) for the period 1980–1984.

[6] Amounts in "Dispensable Funds Flow" less the burden of debt (the after tax interest expense) and burden of equity (dividends) for the period 1980–1984.

[7] Georgia-Pacific had negative dispensable funds in four of the five years. The positive dispensable funds from one year (1980) was so large that the cumulative five-year period showed positive dispensable funds.

[8] International Paper had positive dispensable funds in four of the five years. Like Georgia-Pacific and most other fully integrated paper companies, 1980 was the significant positive year.

to those available from a SFAS No. 95 Statement of Cash Flows have been provided.

The first proposal was to separate operating activities from financing activities. The second proposal was to separate "steady state" operating investments from "growth" operating investments. This separation refined the concept of "steady state" investments and distinguished those amounts that need to be covered by internal funds flow from those that could be externally financed. This approach allows for the provision of information about the firm's ability to: self-finance its operations (summarized in the dispensable funds generated concept), to cover its burden of debt financing (summarized in the distributable funds generated concept), and to cover its burden of equity financing (summarized in the discretionary funds generated concept).

The financial analyst still must estimate both the amount of capital maintenance investments in productive assets and the capital expansion investments that change the operating capacity of existing business or that represent investments in new types of businesses. Operating funds flow presentations that assume that all investments in operating assets are capital maintenance expenditures cannot accurately reflect the state of affairs at all businesses. One disclosure which previously could have been used to approximate this information is no longer required—vis., SFAS No. 89 (FASB 1986b) makes voluntary the replacement cost information required by SFAS No. 33. The FASB rejected specifically requiring firms to provide such information in SFAS No. 95 (FASB 1987b, 97–99) due to subjectivity (lack of reliability) of such amounts. This means that analysts usually must supply their own estimates of steady state investments. Two other sources of information useful in making these estimates were noted earlier.

Three other specific suggestions for refining future estimates were made. Continuing earnings need to be separated from "one shot" earnings. Such a separation would refine the dispensable funds, distributable funds, and discretionary funds generated concept for the appropriate role of financial analysis—estimates of future amounts. The effects of incidental/peripheral activities should be separately disclosed to provide information about the riskiness of future estimates. This is important as incidental and/or peripheral activities may have different risk characteristics than central operating activities. The separate classification into debt and equity financing, the final proposal, also yields information about the financing activities of a firm. Information about financing activities is especially important when a firm has funds flow deficits in dispensable, distributable, and discretionary funds—as it can be used to show the source of funds with which a firm covered the deficit.

These changes yield insights useful in assessing a firm's cash generating ability. Revising the funds flow statements of several firms in troubled industries showed large negative numbers for dispensable, distributable, and discretionary funds. Such an insight is not readily available from traditional funds flow statements.

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Editorial
The Accounting Review: 1987-1989

THIS editorial provides several types of information relating to my just-completed three-year term as Editor and Managing Editor of *The Accounting Review*. First, it analyzes manuscripts received and their review times. Second, it explains some changes in the operation of the *Review*. Finally, it presents some thoughts on the *Review*, its objectives, and its future.

I. Manuscript Statistics 1986–1989

This section reports descriptive statistics on potential Main Articles, Notes and Comments received from June 1, 1986 through May 31, 1989. Submissions are analyzed by area of thought, research method, and review times. Also reported are selected characteristics of the authors and reviewers, and statistics on manuscripts published in the April 1987 through January 1990 issues.

Submissions and Acceptances

Table 1, Panel A summarizes submissions received by month and by editorial year. Overall, 985 new manuscripts were received or about 328 per year. This can be compared with an average over the prior four years of 287 per year (Sundem 1987, 192). The monthly rates do not exhibit a clear seasonal pattern. However, the January and February 1989 submissions were only 54 percent of those for the same months in 1988 and 61 percent of the 1987-1988 mean. This probably reflects the effects of the 100 percent increase in submission fees effective for manuscripts received after December 31, 1988.

In addition to the new submissions, 205 manuscript revisions were received or an average of 68 revisions each year. Thus, there were approximately 397 manuscripts to be reviewed each year or about 1.1 per calendar day. In terms of review reports, if each new manuscript or revision received two reviews, then almost 2,400 review reports would be required.

Table 1, Panel B reports the flows and inventories of manuscripts with authors and with reviewers or awaiting an editorial decision. There is no attempt to match the submissions with the acceptances due to the time lag for some manuscripts. However, there appears to be little change in the composition of the inventories over time. Thus, direct comparison of submissions and acceptances is possible.

Table 2 presents definitions that underlie the classification of manuscripts as to "area" of accounting thought and "method" used. There are many ways to

Table 1
Summary of Manuscript Submissions and Processing
June 1986–May 1989

Panel A. Manuscript Submissions by Month:

Month	1986–1987	1987–1988	1988–1989	Total
	Number of Submissions Each Month			
June	20	23	26	69
July	34	30	37	101
August	34	17	30	81
September	29	28	25	82
October	26	24	31	81
November	24	22	18	64
December	28	19	23	70
January	24	36	22	82
February	34	40	19	93
March	22	31	28	81
April	34	32	30	96
May	29	28	28	85
Total	338	330	317	985

*Panel B. Summary of Manuscripts Processed:**

	1986–1987	1987–1988	1988–1989	1986–1989
Inflow:				
With reviewers or awaiting editorial decision at June 1	104	112	82	104
With authors for revision at June 1	45	75	111	45
New submissions	338	330	317	985
Total	487	517	510	1,134
Outflow:				
Accepted for publication**	23	31	48	102
Rejected	277	293	308	878
With reviewers or awaiting editorial decision at May 31	112	82	87	87
With authors for revision at May 31	75	111	67	67
Total	487	517	510	1,134

* Does not include resubmissions.

** 1986–1987 includes the April 1987–October 1987 issues; 1987–1988 includes the January 1987–October 1988 issues; and 1988–1989 includes the January 1989–January 1990 issues.

classify manuscripts as to "area" and "method" and no single scheme is fully informative since most manuscripts have several possible classifications. The taxonomy chosen is somewhat arbitrary. For example, financial accounting studies are not classified as to the accounting issue or question addressed (such as

Table 2

Definitions of Underlying Classifications

Panel A. Area:

Audit Economics: Economics of the attestation business including: pricing, auditor changes, supply of and demand for auditing.

Audit Procedures: Any aspect of audit evidence or the process of obtaining audit evidence.

Audit Reporting: Any aspect of the issuance or effects of auditors' reports.

"Education": Any aspect of accounting education or other topics that, in the past, might have been published in Education Research (e.g., ratings of universities or publications or attitudes of professors).

Financial Accounting Choices: Any aspect of the choice of accounting methods (excluding those classified as market studies).

Financial Accounting Forecasts: Prediction of earnings or business failure or comparisons of alternative forecasts of earnings (excluding those classified as market studies).

Financial Accounting Standards: Any aspect of the process of determining officially established accounting methods (excluding those classified as market studies).

Financial Accounting—Other: Financial accounting manuscripts not elsewhere classified.

Managerial Accounting: Any aspect of accounting or control within the firm, including production.

Not for Profit Accounting: Accounting for entities that are not conducted for profit, including governmental units but excluding audit pricing for not for profit entities.

Professional: Studies of the attitudes of professional accountants, advice on how to operate an accounting firm, or aspects of ethical behavior.

Systems: Any aspect of accounting systems (does not include tutorials on the use of software by accountants).

Taxation: Any aspect of taxation or tax accounting but excluding financial statement treatment of taxes.

Other: Other manuscripts not otherwise classified as to area.

Panel B. Methods:

Analytical: Use of mathematical or statistical models to address issues in accounting, auditing, systems, or taxation.

Experiments: Use of human subjects to complete a task under prescribed and controlled conditions.

Historical: Use of books, newspapers, and other historical records to infer the state of the world with respect to accounting (excludes the use of quantitative data for analysis).

Passive Observation: Use of data generated without prescription or control of conditions leading to its generation.

Simulation: Analysis of simulated data.

Survey: Human subjects' reports of attitudes or other characteristics or recall of experiences.

Other: Any other methods of inquiry, analysis, or expression, including citations of others, expression of opinions, calls to action, and "logical argument."

inflation accounting or currency translation). Also, some would include studies using the market model or stock price changes to address accounting issues as a "method" rather than an "area." However, stock price studies have many common implications, and classification by financial accounting question led to numerous categories with wide fluctuations by year. Financial accounting questions are segregated into those involving standards setting, accounting method choices and predictive ability or future-oriented studies. Methods focus on the type of data used or method of analysis.[1]

Table 3, Panel A presents a cross classification of the 985 submissions and Panel B presents the classification of the 102 papers published. Table 3 shows that financial accounting subjects (43.7 percent) continue to be the most common submission with auditing (20.0 percent) and managerial accounting (14.5 percent) following. These submission rates can be compared with rates for 1982–1986 of 41 percent, 17 percent, and 18 percent, respectively (Sundem 1987, 195).

Acceptance rates are rather close to the submission rate for many areas and methods. There are exceptions, of course. For example, the survey and "other" methods are underrepresented in acceptances. Also, the classification scheme necessarily hides some other differences in rates. For example, the "Financial Accounting Other × Other" category contains 47 submissions that discuss traditional prescriptive or normative theories of accounting—none of these received favorable recommendations from the expert reviewers and none were accepted.

Review Time

Authors and some Publications Committee members as well as the Editors have expressed concern about the overall review time for manuscripts. Table 4 presents location statistics for first-round review times for the 904 manuscripts included in Table 1, Panel A that had been resolved before June 1, 1989. Specifically, it presents the mean (and median) days from receipt of a manuscript until both reviewers' reports were received for the initial review round.

The overall mean time from receipt of a manuscript until review report(s) were received was 65.5 days (median 58 days). The overall mean time for reviews and an initial editorial decision was 73.9 days (median 63 days). As to the distribution of times, 25.1 percent of the completed reviewers' reports were received within one month of manuscript submissions with an additional 28.3 percent received during the second month and 23.2 percent more in the third month. Thus, almost 77 percent were available for an editorial decision within three months of manuscript submission.

As discussed below, the number of reviewers was varied in an attempt to expedite review time. Therefore, an analysis of review times by number of reviewers was also conducted. For those papers assigned to *one* reviewer, first-round reviews received within one, two, and three months were 54.6 percent, 27.0 percent, and 10.5 percent, respectively, or 92.1 percent overall. For those

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[1] Included in the 985 manuscripts are 11 proposed Comments on seven articles published in *The Accounting Review*. One article generated three proposed Comments, two generated two each, and the others one each. Ten of the proposed Comments were rejected and one was under review at the editorial transition date.

Table 3
Numbers of Submissions and Acceptances by Area and Method

Area	Method							
	Analytical	*Experiments*	*Historical*	*Passive Observation*	*Simulation*	*Survey*	*Other*	*Total*
Panel A. Submissions (June 1, 1986–May 31, 1989):								
Financial Accounting								
Forecasts	1	5	0	53	1	0	2	62
Market model	11	1	0	76	1	0	3	92
Method choice	0	0	0	23	0	0	0	23
Standards	2	0	1	17	0	0	4	24
Other	29	10	10	96	0	5	79	229
Managerial Accounting	46	37	1	18	0	15	26	143
Auditing								
Economics	10	9	2	40	0	3	5	69
Procedure	10	56	0	17	13	8	7	111
Reporting	1	4	2	8	0	2	0	17
Not for Profit	4	1	2	15	0	4	5	31
Professional	4	4	0	5	0	11	6	30
Systems	7	1	0	0	0	5	8	21
Taxation	5	12	2	24	1	5	9	58
"Education"	0	1	1	4	0	7	11	24
Other	9	1	2	8	1	0	30	51
Total	139	142	23	404	17	65	195	985

Table 3—*Continued*

Area	Method *Analytical*	 *Experiments*	 *Historical*	 *Passive Observation*	 *Simulation*	 *Survey*	 *Other*	 *Total*
Panel B. Acceptances (April 1987–January 1990):								
Financial Accounting								
Forecasts	0	0	0	6	0	0	0	6
Market model	2	0	1	19	1	0	0	23
Method choice	0	0	0	9	0	0	0	9
Standards	0	0	0	1	0	0	0	1
Other	2	1	0	8	0	0	1	12
Managerial Accounting	4	5	0	0	0	0	0	9
Auditing								
Economics	0	0	0	7	0	0	0	7
Procedure	1	10	0	1	2	2	0	16
Reporting	0	1	0	3	0	0	0	4
Not for Profit	0	1	1	2	0	0	0	4
Professional	0	0	0	1	0	0	0	1
Systems	1	0	0	0	0	0	0	1
Taxation	3	2	0	3	0	0	0	8
"Education"	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	1	1
Total	13	20	2	60	3	2	2	102

Table 4
Analysis of Initial Review Time Measured in Calendar Days by Area and Method
n=904 completed manuscripts
1986–1989

Panel A. Means and Median by Area and Method:

Area	*Mean*	*Median*	n	*Method*	*Mean*	*Median*	n
Financial Accounting Standards	82.8	70	(21)	Experiments	94.5	78	(129)
Audit Procedures	80.7	72	(103)	Analytical	78.1	67	(121)
Audit Reporting	78.1	71	(16)	Passive Observation	68.6	62	(369)
Financial Accounting Choices	77.9	69	(22)	Historical	64.3	51	(21)
Managerial Accounting	77.2	68	(132)	Simulation	57.8	56	(16)
Financial Markets	74.3	66	(88)	Survey	43.9	41	(58)
Audit Economics	69.3	62	(57)	Other	39.8	24	(190)
Financial Accounting Forecasts	66.1	56	(57)				
Not for Profit Accounting	62.2	53	(27)	Total	65.6	58	(904)
Financial Accounting—Other	58.4	52	(212)				
Professional	55.4	38	(27)				
Systems	53.2	42	(21)				
Taxation	50.1	51	(52)				
Other	46.5	6	(46)				
"Education"	21.1	5	(23)				
Total	65.6	58	(904)				

Panel B. Analysis of Variance:

	df	*F-statistic*	*Prob.* F
Area	14	1.42	.135
Method	6	4.37	.001
Area × method	55	1.04	.311

[1] Number of days from receipt of manuscript at the *Review*'s office until receipt of the reviewers'('s) reports for the intial review.

assigned to *two* reviewers, the rates were 2.6 percent, 30.4 percent, and 33.8 percent with an additional 14.1 percent during the fourth month, or only 80.9 percent within four months. Thus, there is considerable economy as to review time with the use of a single reviewer.

An analysis of variance of review times by area, method, and the area × method interaction is presented in Table 4, Panel B. The ANOVA shows highly significant differences by method with insignificant area effects and interactions. As to method, experiments had by far the lengthiest mean review times (94.5 days) and its relatively lower median (78 days) indicates considerable positive skewness. "Other methods" had the shortest with (39.8 days) and surveys were second shortest (43.9 days). The latter means are low, in part, because their subject matter often did not comply with the Editorial Policy of *The Accounting Review* (note that the "education" and "other areas" had medians of five and six days). Many of these papers were not assigned for outside review. As to the experiments, the pool of researchers competent to review experiments is relatively small and, although the reviewers provided thorough and competent reviews, it was often difficult to obtain prompt reviews.

Authors and Reviewers

As was the case during the Sundem years, there has been broad participation in the activities of *The Accounting Review*. The 985 manuscripts were authored by a total of 1,001 different authors from 390 different employers including 20 businesses and governmental and private agencies. Six hundred thirty-one authors submitted a single manuscript while 238 submitted two, 71 submitted three, and 40 submitted four. At the upper end of the distribution, one author submitted nine manuscripts and one submitted 11 (none of the latter 20 were successful). Authors from 174 different employers submitted a single manuscript and authors from another 145 employers submitted from two to five each. The two largest employer/submitters submitted 35 and 40 manuscripts, respectively (none of the latter 75 were published). As to published articles, 74 colleges and universities and the FASB are represented.

Finally, 392 different reviewers reviewed manuscripts. Of these, the maximum number of manuscripts reviewed by an individual outside reviewer was 20, and the second highest was 18. Eighteen others reviewed from 11 to 15 manuscripts each.

II. Changes in *The Accounting Review*
1987–1989

The beginning of my term of office coincided with a major change in the publications of the American Accounting Association and a significant increase in volume of submissions to *The Accounting Review*. Each of these developments had a considerable effect on the operation of the journal.

Due to the Publications Committee

During 1986, the Executive Committee of the Association decided to publish *Accounting Horizons* (*AH*) and *Issues in Accounting Education* (*IAE*) as Association journals. At the same time, the Publications Committee was formed to oversee all Association publications.

At one of its first meetings the Publications Committee decided that the three Association journals should have "equal status" and that each should establish a "special, high quality niche" (Sprouse 1987, 6–8). Therefore, they concluded: "An Association journal should not devote a *special section* to subject matter that falls within the *purview* of another Association journal" [emphasis added]. Education Research and Financial Reporting sections of the *Review* were mentioned as unnecessary under the new policy but the Committee's intent as to purview and special sections was not clear (at least not to me).

As to purview, the Committee stated (p. 7):

> The focus of *IAE* should be to publish only articles addressing some aspect of accounting education.

and

> *AH* will publish articles . . . of interest to practicing accountants . . . ; educators; students; and others who have a strong interest in contemporary accounting theory, practice, and policy.

The *Review* was to publish articles "reporting the results of accounting research. . . ." There was little difficulty in identifying papers that addressed education issues. However, as a practical matter, the Committee's statements about purview of *AH* and the *Review* were not necessarily mutually exclusive.

The Committee also decided that eliminating the Education Research and Financial Reporting sections would "in no way preclude *The Accounting Review* from publishing the types of articles that currently appear in those special sections" if editorial standards were maintained (p. 7). Furthermore, the *Review*'s "liaison" committee member informed me that the *Review* could still publish an education-related paper "if it was research—for example, if it used regression analysis," but that it couldn't be published in a section entitled, "Education Research." Thus, it was unclear as to whether content or the section status was at issue.

I agreed that *IAE* and *AH* should be of high quality. I did not agree that their quality should come by dismantling two successful sections of *The Accounting Review*. However, these two sections were eliminated. The October 1987 issue closed the Financial Reporting section and the October 1988 issue included the final education-related manuscript. The latter ended the forty-one year history of an accounting education section in the *Review*. The Education Research section began in January 1971 and its forerunner, the "Teacher's Clinic," began in January 1948.

Since *IAE* was to publish accounting education-related articles, the Book Review Editors of the *Review* and *IAE* decided that the *IAE* should include reviews of all accounting textbooks and other education-related materials. The *Review*'s Book Review Editor would then concentrate on scholarly books in accounting and could increase the number of pages devoted to scholarly books.

To reflect the elimination of education-related papers from consideration and to continue the evolution of the Editorial Policy of *The Accounting Review*, the Policy Statement was revised in the April 1988 issue. The new statement continued the longstanding practice of considering all areas of accounting thought and all research methods. The overall statement was simple:

> *The Accounting Review* publishes results of systematic inquiries in any area of accounting. The primary criterion for publication is the significance of the results as a contribution to accounting thought.

Beginning with the January 1988 issue a special section entitled Small Sample Studies was added. After much discussion with Association members, Editorial Review Board members, and the then Associate Editors, Professor Ed Barrett (who had served as Editor of the Financial Reporting section) and I decided that there was need for a vehicle to provide encouragement for "scholarly inquiries intended to integrate theories of and about accounting and accounting practice through analyses of accounting issues in the context of a small number of real world settings" (*The Accounting Review* 1988, 328). Ed Barrett agreed to be the Editor of the new section.[2]

Small Sample Studies could include topics in financial reporting (both internal and external), as well as other areas of managerial accounting, auditing, systems, and taxation accounting. Therefore, the section encompassed more than the purview of *AH*. Also, as had been the case for Financial Reporting, manuscripts submitted for consideration as Small Sample Studies were reviewed by members of the Editorial Review Board and subject to the same quality control mechanism as Main Articles, Notes, and Comments. Thus, Small Sample Studies met all criteria established by the Publications Committee. The Committee was informed of my intent to add the new section and did not object officially to its formation.

From January 1988 through January of 1990, ten Small Sample Studies were published. Topics have included issues in external reporting, internal reporting, auditing, and accounting systems design, as well as the basis of accounting method choice and its interaction with taxes.

Due to Increased Volume of Submissions

As the analysis of Section I indicates, during my first year the submission volume at *The Accounting Review* increased almost 18 percent over the prior four year average. This increased the problem of obtaining competent, thorough, and prompt referee reports and placed a heavier editorial burden on the Editor.

In response, I asked the Publications Committee and the Executive Committee to allow dividing the editorial duties among myself and three additional Editors. All four of us would have the authority to accept or reject manuscripts but I would retain final responsibility for publication and oversight of the entire process. Professors Bob Libby, Bob Magee, and Jerry Salamon agreed to serve as Editors for the 1988–1989 years. Each served as Editor for a portion of the submissions in the area of their special expertise and they accepted a total of 16 manuscripts for publication.

The new multiple Editor system allowed several advantages to the *Review*, its authors, and its readers. First, more expertise was placed close to the authors since, with proper assignment, each Editor could be more expert in the area of a paper than could a single Editor. Second, overall review turnaround time could be reduced since each Editor would be less burdened, and third, for some papers the Editor could serve as a reviewer of the manuscript. Over the two-year period in which the new system has been in effect, the *Review* has used two reviewers on 338 of the 647 new manuscripts received (or 52 percent) while one reviewer was used on the remaining 309 (or 48 percent).

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[2] In 1990 the *Journal of Financial Economics* will begin a new special section for studies in financial economics. Its editorial policy and intent is essentially similar, and parallel to that of Small Sample Studies.

A second initiative to reduce the burden on reviewers was a policy of the assigning of no more than six new manuscripts per year to a particular Editorial Review Board member. In prior years, 12 have been the norm. I felt that with one new manuscript per month plus possible revisions as well as requests from editors of other journals, some Board members would be overburdened and the quality of review might suffer. Also, I wanted to reduce the incentives to recommend rejection just to reduce one's workload. The reduction of the maximum was balanced by the one reviewer system and the use of more *ad hoc* reviewers. The new maximum was exceeded only once.

III. Some Comments on the Operation of *The Accounting Review*

As my term as Editor ends, it seems appropriate to comment on the philosophy under which the *Review* has been operated. This I will do and I will also comment on the debts that I owe to those who have assisted in the operation of the journal.

With a single exception, I have not sought particular manuscripts nor have I attempted to steer the Main section of the journal in any particular direction. All manuscripts in all areas of thought and all methods of analysis have been considered. This eclectic approach is, I believe, appropriate for a discipline as dynamic as accounting and also appropriate for an association's research journal. As the analysis of Section I indicates, all areas are not equally represented in submissions and the acceptance rates are not equal. However, the opportunities were as nearly equal as I could make them.

Papers that have been successful have, other things equal, tended to make a contribution to *accounting* thought (broadly defined) and the broader the contribution, the better. In fact, breadth of contribution and breadth of interest by readers has been central in editorial decisions. There have been many seemingly worthy submissions addressing rather narrow topics in auditing, taxation, and information systems that have been rejected with a suggestion that they be sent to a more specialized journal.

Successful papers have also indicated early in the paper, (1) what issue is being addressed, (2) why the issue is an important one, and (3) how the issue is addressed. Many of them have indicated whether the incremental contribution of a paper was through the use of new data, use of a new estimation or research method, or a new theory as to how real-world facts are related to each other. Finally, most successful papers have been economically presented and exhibited careful exposition that allows the reviewer to focus on what is at issue and efficiently make an evaluation on the merits of the paper itself (it is ironic that many manuscripts that, in essence, address the economics of information, are often not presented economically).

For the future, I believe that it *must* be recognized that *The Accounting Review* competes with other broad interest scholarly journals in accounting. While broad distribution of the journal and Asociation status work in favor of the *Review*, it also has less continuity of leadership and reviewers are not paid by the Association. These factors need to be considered by the Publications Committee before further restricting the ability of the *Review* to compete for high quality scholarly manuscripts.

Acknowledgments

I would like to express my appreciation to the authors, editors, and reviewers for their part in making *The Accounting Review* work for the past three years. The authors have provided a "reasonable" supply of high quality manuscripts for review, and I believe that supply has increased over the period.

Two Section Editors and the Book Review Editor have contributed greatly to the overall success of the *Review*. Frank Selto continued as Editor of Education Research and made possible its successful completion. Ed Barrett served as both the Financial Reporting and Small Sample Studies Editor. His leadership was central in penetrating the narrow window of opportunity to facilitate publication of small sample studies in accounting. Finally, Dick Brief did an admirable job in fine tuning the scholarly focus of the Book Reviews.

Joel Demski and Bob Holthausen served as Consulting Editors and provided expert advice on how best to resolve differences of opinion as to the scholarly merits of several difficult papers. Their efforts were of great assistance and comfort to the Editor.

As mentioned above, Bob Libby, Bob Magee, and Jerry Salamon served as Editors for the latter two years of my term. They helped make good papers better and helped authors see some subtle but significant flaws in their work. I would not have been able to complete my term without these Editors' efforts and I believe that their participation was essential in the effort to maintain quality of output in the face of increased volume of submissions and the increasing breadth of inquiries into accounting matters.

Finally, an acknowledgment of reviewers. On many occasions, I have stated that competent, thorough, and prompt reviewers are the most critical component in the review process and the factor in shortest supply. Because of their great value and short supply, I have tried to conserve review resources through several means including reviewing many marginal papers myself.

As Editor, I have learned to appreciate the exceptional talent and willingness to serve of many members of the Editorial Review Board and *ad hoc* reviewers. There is a core group of reviewers that cuts across areas and methods and whose members regularly provide competent, thorough, and prompt review reports (I have also learned of others who are competent but have only one of the other two characteristics). The reviewers who have been so helpful have my sincere thanks and continuing appreciation.

WRKJ

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2. To suggest ways to improve the interfacing, including potential AAA activities, aimed at achieving the objectives of improved coordination within the total accounting community and overall greater effectiveness in advancing the field of accounting.

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2. To inform the AAA Executive Committee of relevant accreditation issues and recommend policies or positions as appropriate.

3. To maintain communication with the AAPG Accreditation Committee.

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2. To examine the measurement issues involved in extending accounting information and the audits of such information to fulfill important types of unmet user information needs.

3. To demonstrate what extended measurement entails with guidance and illustration.

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Charge: 1. To develop and issue position statements on matters relating to accounting education.

2. To develop and recommend to the Executive Committee educational policy for the Association.

3. To initiate, coordinate, and administer the activities of the Association in the field of accounting education, including accounting education research and continuing professional education. Effective liaison with regions and sections is an integral part of this responsibility.

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Chairperson: Theodore J. Mock, University of Southern California
James R. Boatsman, Arizona State University
James L. Chan, University of Illinois at Chicago
George J. Foster, Stanford University
Rita Hull, Virginia Commonwealth University
Robert S. Kaplan, Carnegie Mellon University

ALTERNATE ACCOUNTING EDUCATION MODELS COMMITTEE

Charge: 1. To collect and/or develop materials that describe and evaluate alternative degree program models for implementing a 150-hour program in accounting, including the role of various types of colleges and universities in each model (for example, two-year; four-year; graduate only).

2. To describe and evaluate the relative coverage of broad subject areas such as liberal arts, business, and accounting for each model as well as the profiles of the graduates and their potential comparative advantages in the accounting marketplace.

Chairperson: Jan R. Williams, University of Tennessee
James W. Deitrick, University of Texas at Austin
John A. Elliott, Cornell University
Brent C. Inman, Coopers & Lybrand
Philip R. Regier, Arizona State University
Philip H. Siegel, San Francisco State University

BYLAWS COMMITTEE

Charge: To review the Association's Bylaws and recommend appropriate revisions to the Executive Committee.

Chairperson: Roger Hermanson, Georgia State University
Philip J. Harmelink, University of New Orleans
Lorraine Hicks, State Technical Institute at Memphis
Joseph J. Schultz, Arizona State University

CARTER SCHOLARSHIPS COMMITTEE

Charge: 1. To collect and evaluate applications for the Carter Foundation Student Scholarships.
2. To recommend amounts of stipends.
3. To rank applications and to transmit the ranking to the trustees of the Foundation.

Chairperson: Donald E. Kieso, Northern Illinois University
Allen Ford, University of Kansas
Eldon C. Lewis, California State University

COMPETITIVE MANUSCRIPT AWARD COMMITTEE

Charge: To select one, two, or at most, three recipient(s) of the Competitive Manuscript Award using criteria approved by the Executive Committee.

Chairperson: Gerald L. Salamon, Indiana University
Frances L. Ayres, University of Oklahoma
David C. Burgstahler, University of Washington
Bala G. Dharan, Rice University
David F. Larcker, University of Pennsylvania
William S. Waller, University of Arizona

CORPORATE ACCOUNTING POLICY SEMINARS COMMITTEE

Charge: 1. To plan the 1990 inaugural Corporate Accounting Policy Seminar.
2. Upon approval and funding to arrange to have the consortium conducted and administered
3. To report on its results, effectiveness, and recommended changes by November 1, 1990.

Chairperson: James Don Edwards, University of Georgia
Charles G. Carpenter, Miami University
Scott S. Cowen, Case Western Reserve University
Eugene Flegm, General Motors Corporation
William Ihlanfeldt, Shell Oil Company
Edward J. Joyce, University of Minnesota
Phyllis Minnott, Eli Lilly & Company
Jane F. Mutchler, University of Arizona

DELOITTE HASKINS & SELLS WILDMAN MEDAL COMMITTEE

Charge: To administer the John R. Wildman Medal award program in accordance with the terms of the grant from the Deloitte Haskins & Sells Foundation.

Chairperson: Marcos F. Massoud, Claremont McKenna College
Clifton E. Brown, University of Illinois
Susan F. Haka, Michigan State University
C. Jevons Lee, Tulane University
William F. Messier, University of Florida
Maurice E. Stark, Kansas State University
Lester M. Sussman, Deloitte Haskins & Sells

DOCTORAL CONSORTIUM COMMITTEE

Charge: 1. To plan the 1990 Doctoral Consortium in accordance with established AAA policies.
2. Upon approval and funding, to arrange to have the consortium conducted and administered.
3. To report on its results, effectiveness, and recommended changes by November 1, 1990.

Chairperson: Robert H. Ashton, Duke University
John W. Dickhaut, University of Minnesota
D. Paul Newman, University of Texas at Austin
Victor Bernard, University of Michigan

DOCTORAL PROGRAMS COMMITTEE

Charge: 1. To evaluate prior Doctoral Program Conferences and recommend to the Director of Education whether or not this program should be continued and, if so, to develop a plan for a Doctoral Program Conference to be held in 1991.

2. Report committee findings and recommendations including plans for a 1991 conference, if appropriate, to the Executive Committee by August 1, 1990.

3. To recommend other steps the Associationn should take to improve the quality of doctoral programs in accounting.

Chairperson: Charles H. Smith, Penn State University
Michael Gift, University of South Florida
Robert Knechel, University of Florida
J. Hal Reneau, Arizona State University

EMERGING ISSUES COMMITTEE

Charge: 1. To assimilate the recent strategic planning thrusts of the AAA, AICPA, and other relevant professional accounting organizations.

2. To determine appropriate consequences for AAA forward planning with respect to programs and organizational matters.

3. To advise the AAA President-Elect accordingly.

Chairperson: Alvin A. Arens, Michigan State University
William H. Beaver, Stanford University
Phil Chenok, American Institute of Certified Public Accountants
Rick Elam, American Institute of Certified Public Accountants
Jim Liesenring, Financial Accounting Standards Board
Shawn O'Malley, Price Waterhouse
Ray M. Sommerfeld, University of Texas at Austin

FINANCIAL ACCOUNTING STANDARDS COMMITTEE

Charge: 1. To evaluate selected discussion memoranda and exposure drafts related to financial accounting and reporting in the private sector as they are released by the FASB and to respond to the FASB in writing and by appearing at selected public hearings.

2. To be cognizant of emerging issues related to financial accounting and reporting in the private sector through materials issued by the Emerging Issues Task Force and other relevant sources with evaluation, where appropriate, of the significance and potential implications of such issues.

3. To meet with the FASB, normally on an annual basis.

4. To explore the publication of selected responses by the committee in *Horizons* or other appropriate outlets.

5. To consider and promote ways to increase the academic input to the standard setting process.

Chairperson: Jerry J. Weygandt, University of Wisconsin
Alex T. Arcady, Ernst & Whinney
William A. Collins, University of North Carolina
Loyd C. Heath, University of Washington
William W. Holder, University of Southern California
Charles McDonald, University of Florida
Lawrence Revsine, Northwestern University
Lawrence A. Tomassini, University of Illinois
Arthur Wyatt, Arthur Andersen & Co.

HISTORY PROJECT ADVISORY COMMITTEE

Charge: 1. To prepare project specifications including a project budget.

2. To select the project author(s).

3. To supervise the execution of the project with the objective of obtaining a monograph by the time of the AAA Annual Meeting in 1991.

Chairperson: Thomas J. Burns, The Ohio State University
Stephen A. Zeff, Rice University
Thomas J. Nessinger, Arthur Andersen & Co.

INTERNATIONAL FACULTY EXCHANGE COMMITTEE

Charge: 1. To select the professors to be involved in the program for 1990–1991.
2. To assist the Executive Director with announcements, arrangements, and follow-up evaluations for the respective visits.

Chairperson: Paul A. Griffin, University of California
Timothy S. Doupnik, University of South Carolina
Thomas G. Evans, Bowling Green State University
James M. Fremgen, Naval Postgraduate School
Kazuo Hiramatsu, Kwansei Gakuin University
Lauren Kelly, University of Washington

INVESTMENTS COMMITTEE

Charge: To recommend how AAA funds should be invested in accordance with established Executive Committee policies and procedures.

Chairperson: Joseph J. Schultz, Arizona State University
Mike Crooch, Arthur Andersen & Co.
Frank R. Rayburn, University of Alabama
Robert K. Zimmer, University of Denver

MEMBERSHIP COMMITTEE

Charge: To increase the quantity and quality of the membership of the Association.

Chairperson: Richard J. Murdock, Ohio State University
Michael E. Egan, Arthur Young & Company
David J. Ellison, Creighton University
James R. Hasselback, Florida State University
Karen B. McCarron, Georgia State University
Glenn E. Owen, University of California
P. David Shields, Texas A&M University
John Willingham, Peat Marwick Main & Co.

State Coordinators

Alabama—Richard H. Tabor, Auburn University
Alaska—Clifford Cox, University of Alaska–Fairbanks
Arizona—Fred Mittelstaed, Arizona State University
Arkansas—Keith Sellers, University of Arkansas Community College
California—O. Douglas Moses, Naval Postgraduate School
Colorado—Hugh Grove, University of Denver
Connecticut—George P. Generas, University of Hartford
Delaware—Nancy Magrone, Delaware Technical and Community College
Florida—Judith Welch, University of Central Florida
Georgia—Gary Winkle, Georgia State University
Hawaii—Shirley J. Daniel, University of Hawaii -Manoa
Idaho—Lela M. Pumphrey, Idaho State University
Illinois—Linda Leinicke, Illinois State University
Indiana—Peggy S. Hite, Indiana University–Bloomington
Iowa—Ramaurthy Balkrishnan, University of Iowa
Kansas—Dan Deines, Kansas State University
Kentucky—Marshall Robertson, Lexington Community College
Louisiana—Alan B. Deck, Southwest Louisiana
Maine—Marshall A. Geiger, University of Maine
Maryland—Marc LeClere, University of Maryland
Massachusetts—Mario Maletta, Northeastern University
Michigan—Joseph H. Anthony, Michigan State University
Minnesota—Quentin N. Gerber, Saint Cloud State University
Mississippi—Edward E. Milam, University of Mississippi
Missouri—David B. Byrd, Southwest Missouri State University
Montana—Bruce P. Budge, University of Montana
Nebraska—Richard G. File, University of Nebraska–Omaha
Nevada—John Strefeler, University of Nevada–Reno
New Jersey—Jacqueline B. Sanders, Mercer County Community College
New Mexico—Sherry K. Mills, New Mexico State University

New York—Sanford C. Gunn, SUNY-Buffalo
North Carolina—Beverly Terry, Central Piedmont Community College
North Dakota—Duwayne M. Wacker, University of North Dakota
Ohio—William Lucas, Stark Technical College
Oklahoma—Leslie Dunlap, Tulsa Junior College
Oregon—Duane J. Hought, Central Oregon Community College
Pennsylvania—Jack Topiol, Community College of Philadelphia
Rhode Island—Carol J. McNair, University of Rhode Island
South Carolina-William Baker, University of South Carolina
South Dakota—Ronald J. Beckman, University of South Dakota
Tennessee—Kenneth A. Austin, Memphis State University
Texas—T. Michael McCarty, Texas Christian University
Utah—Keith R. Howe, Brigham Young University
Vermont—Bruce Committe, University of Vermont
Virginia—James A. Yardley, Virginia Tech
Washington—W. Ron Singleton, Western Washington University
West Virginia—Patricia Shafer, West Virginia State College
Wisconsin—Darryll L. Craig, University of Wisconsin-Milwaukee
Wyoming—J. David Malone, University of Wyoming

MINORITY FACULTY DEVELOPMENT COMMITTEE

Charge: 1. To examine and monitor minority recruitment programs of other professional organizations, such as the AICPA programs.

2. To explore ways in which potential minority candidates can be encouraged to apply to accounting doctoral programs and to pursue professional careers in accounting education.

3. To explore ways in which to encourage the development of minority faculty members.

Chairperson: Mark Kiel, North Carolina A&T State University
Eula Adams, Touche Ross
John M. Hassell, University of Texas at Arlington
Cheryl R. Lehman, Hofstra University
Maria Trini Melcher, California State University-Fullerton
Jenice P. Stewart, University of Missouri at Columbia
Talmadge C. Tillman, Jr., California State University-Long Beach

NEW FACULTY CONSORTIUM COMMITTEE

Charge: To plan the 1990 New Faculty Consortium in accordance with established AAA policies, to arrange to have the Consortium conducted and administered, to report on its results and effectiveness, and to recommend changes (if any) to the Executive Committee.

Chairperson: Bruce A. Baldwin, Arizona State University
Michael A. Diamond, University of Southern California
Helen Gernon, University of Oregon
Mikel G. Tiller, Indiana University

NOMINATIONS COMMITTEE

Charge: To select a list of nominees to AAA offices for election by the membership in August 1990.

Chairperson: Ray M. Sommerfeld, University of Texas at Austin
William H. Beaver, Stanford University
Robert G. May, University of Texas at Austin
Shane R. Moriarity, University of Oklahoma
Gerhard G. Mueller, University of Washington
Ira Solomon, University of Illinois
Mary S. Stone, University of Alabama

PEAT MARWICK MAIN AUDITING PRACTICE & RESEARCH SEMINARS COMMITTEE

Charge: To assist Peat Marwick Main & Co. in the continuing conduct of the auditing seminars series.

Chairperson: Robert G. May, University of Texas at Austin
Andrew D. Bailey, Jr., Ohio State University
Stanley F. Biggs, University of Connecticut

PROFESSIONAL EXAMINATIONS COMMITTEE

Charge: 1. To monitor the Practice Analysis being conducted by the AICPA and evaluate the implications for the CPA Examination.

2. To evaluate the relationship between licensure and accounting education objectives in determining the appropriate format and content of the exam.

3. To explore innovative approaches to the construction of objective type questions including the construction of sample questions.

Chairperson: W. Steve Albrecht, Brigham Young University
Robert Glen Berryman, University of Minnesota
James Blum, American Institute of Certified Public Accountants
O. Whitfield Broome, University of Virginia
William N. Kulsrud, Indiana University
Patrick B. McKenzie, Arizona State University
Alan Reinstein, Wayne State University

PROFESSIONALISM AND ETHICS SEMINARS COMMITTEE

Charge: 1. To plan a "Professionalism and Ethics" seminar for 1990, in accordance with established AAA policies.

2. Upon approval and funding, to arrange to have the seminar conducted and administered.

3. To report on its results and effectiveness together with recommendations for changes by November 1, 1990.

Chairperson: Harold Langenderfer, University of North Carolina
Donald Baker, Arthur Andersen & Co.
Jane O. Burns, Texas Tech University
Stephen E. Loeb, University of Maryland
William May, University of Southern California
Kenneth A. Merchant, Harvard University
Frederick L. Newmann, University of Illinois
Joanne Rockness, North Carolina State University
Robert J. Sack, University of Virginia

PROGRAM ADVISORY COMMITTEE

Charge: To assist the President and the Executive Director in developing the technical program for the 1990 annual meeting.

Chairperson: Gary J. Previts, Case Western Reserve University
Vice Chairperson: Andrew D. Bailey, Jr., Ohio State University
Vice Chairperson: Belverd E. Needles, Jr., DePaul University
Anthony Atkinson, University of Waterloo
Mary Schroeder Doucet, University of Georgia
C. Dwayne Dowell, Abilene Christian University
Robert K. Eskew, Purdue University
John Harry Evans, University of Pittsburgh
Helen Gerrard, Miami University
Karl Hackenbrack, University of Florida
Trevor S. Harris, Columbia University
Hartwell C. Herring, University of Tennessee
Richard Frank Kochanek, University of Connecticut
Robert Mednick, Arthur Andersen & Co.
Rayman Meservy, Carnegie Mellon University
Jane Mutchler, University of Arizona
Cherie O'Neill, Virginia Polytechnic Institute and State University
Robert W. Parry, Indiana University
Karen V. Pincus, University of Southern California
Judy Rayburn, University of Minnesota
Michael A. Robinson, Abilene Christian University
Robert L. Simons, Harvard University
Ira Solomon, University of Illinois
Paul J. Steinbart, Memphis State University
Shyam Sunder, Carnegie Mellon University
Richard Vangermeersch, University of Rhode Island

PUBLICATIONS COMMITTEE

Charge: 1. To monitor all aspects of the Association's growing publications program.

2. To report periodically to the President and Executive Committee on all matters of concern in the field of publications.

3. To recommend candidates for editor or editor-elect positions as appropriate.
4. To recommend AAA publications policies to the Executive Committee as deemed desirable.

Chairperson: Daniel W. Collins, University of Iowa
Chee Chow, San Diego State University
William L. Felix, Jr., University of Arizona
Yuji Ijiri, Carnegie Mellon University
Robert W. Ingram, University of Alabama
William R. Kinney, Jr., University of Texas at Austin
Stephen Zeff, Rice University

RESEARCH ADVISORY COMMITTEE

Charge: 1. To monitor the accounting research activities of other accounting associations, e.g., AICPA, FEI, IIA, and NAA.

2. To advise the Director of Research in the development and administration of the Association's program in accounting research.

3. To suggest ways to encourage research in accounting, especially applied research dealing with all accounting functions in enterprise settings.

Chairperson: Shyam Sunder, Carnegie Mellon University
Matthew J. Anderson, Michigan State University
Paul J. Beck, University of Illinois
Srikant Datar, Carnegie Mellon University
Patricia J. Hughes, University of Southern California
Baruch Lev, University of California–Berkeley

SCREENING COMMITTEE: NOTABLE CONTRIBUTIONS TO ACCOUNTING LITERATURE AWARD

Charge: To identify works of exceptional merit from published accounting books and articles that meet the guidelines for the "Notable Contribution" awards established by the Executive Committee. Recommendations should be broad enough to provide flexibility to the Selection Committee in determining the recipient(s).

Chairperson: Dan S. Dhaliwal, University of Arizona
John C. Anderson, Syracuse University
Stephen Asare, University of Florida
Jean Bedard, Universite of Laval
Joyce E. Berg, Washington University
Bruce Bublitz, University of Kansas
Stephen A. Butler, University of Oklahoma
Jane Butt, Florida State University
Ronald A. Davidson, University of Calgary
Ronald A. Dye, Northwestern University
Nabil S. Elias, University of Manitoba
Estelle Faier, Metropolitan Technical College
Michael H. Granof, University of Texas at Austin
Richard T. Helleloid, University of Michigan
Robert E. Holtfreter, Fort Hays State University
William S. Hopwood, University of Houston
Betty R. Jackson, University of Colorado at Boulder
George K. Kanaan, Concordia University
Wayne Landsman, University of California–Los Angeles
Joseph Magliolo III, University of Pennsylvania
Rene P. Manes, Florida State University
William E. McCarthy, Michigan State University
Linda S. McDaniel, University of Washington
James C. McKeown, Pennsylvania State University
Roseanne M. Mohr, Portland State University
J. Christian Olsen, University of Texas at Austin
Christopher Petruzzi, New York University
David Plumlee, Kansas State University
Donald E. Ricketts, University of Cincinnati
Stephen Ryan, Yale University
Gary J. Saunders, Kent State University
Konduro Sivaramakrishnan, Carnegie Mellon University
Abbie Smith, University of Chicago
Gerald Smith, University of Northern Iowa
Kay Stice, University of Arizona
Dan N. Stone, University of Illinois
Brett Trueman, University of California–Berkeley
Richard Tubbs, University of Iowa
Carl S. Warren, University of Georgia
John H. Waterhouse, University of Alberta
John S. Watts, University of Chicago
Richard P. Weber, Michigan State University
David D. Williams, Ohio State University
Paul F. Williams, North Carolina State University
Adrian Wong-Boren, San Diego State University
David W. Wright, University of Michigan

SECURITIES AND EXCHANGE COMMISSION LIAISON COMMITTEE

Charge: 1. To prepare and transmit a response to the staff of the Securities and Exchange Commission on proposals soliciting views from the public concerning auditing and financial accounting and reporting.

2. To make recommendations and to develop program(s) that will assist teaching of and conducting research in topics concerning the SEC and its activities.

3. To conduct activities as appropriate to assist communications and interactions between the SEC and the membership of the Association.

Chairperson: Ray G. Stephens, Securities and Exchange Commission
Ray Perry, Touche Ross
Bill N. Schwartz, Temple University
David B. Smith, Claremont McKenna College
Mary S. Stone, University of Alabama

SELECTION COMMITTEE: NOTABLE CONTRIBUTIONS TO ACCOUNTING LITERATURE AWARD

(JOINT COMMITTEE WITH THE AICPA)

Charge: To select the recipient(s) of the award from those books and articles identified by the Screening Committee as potentially notable accounting literature contributions.

Chairperson: Roland E. Dukes, University of Washington
Gerald A. Feltham, University of British Columbia
Barry Lewis, University of Colorado at Boulder
James A. Ohlson, Columbia University
Kurt J. Pany, Arizona State University

SENIOR FACULTY CONSORTIUM COMMITTEE

Charge: 1. To plan the 1990 Inaugural Senior Faculty Consortium.

2. Upon approval and funding to arrange to have the consortium conducted and administered.

3. To report on its results, effectiveness, and recommended changes by November 1, 1990.

Chairperson: Loren Nikolai, University of Missouri at Columbia
Gary C. Biddle, University of Washington
Nicholas Dopuch, Washington University
Thomas P. Howard, University of Missouri at Columbia
Jay M. Smith, Jr., Brigham Young University

SEVENTH INTERNATIONAL CONFERENCE ON ACCOUNTING EDUCATION (1992) PLANNING COMMITTEE

Charge: To continue planning for the conference.

Chairperson: Belverd E. Needles, Jr., DePaul University
Amin A. Elmallah, California State University at Sacramento
Thomas A. Gavin, University of Tennessee at Chattanooga
Sidney J. Gray, University of Glasgow
W. Morley Lemon, University of Waterloo
William Markell, University of Delaware
Seigo Nakajima, Ferris Jogakuin Women's College
Norlin G. Rueschhoff, University of Notre Dame
Murray H. Wells, University of Sydney

STRATEGIC PLANNING COMMITTEE

Charge: 1. To review relevant prior committee reports that considered issues relating to the structure and operations of the Association and identify the status of recommendations included in such reports as to implementation.

2. To develop a framework for a comprehensive review of the operations of the Association aimed at maximizing the future effectiveness and efficiency of the Association.

3. To the extent feasible, in the absence of the results of a comprehensive operating review, evaluate the following two areas: (1) the existing criteria for the establishment and continuation of a section, and (2) the role and administration of continuing professional education within the Association.

Chairperson: Frank R. Rayburn, University of Alabama
David A. Dittman, University of Minnesota
Donald J. Kirk, Columbia University
Jack L. Krogstad, Creighton University
Kermit D. Larson, University of Texas at Austin
Dave Pearson, Arthur Young & Co.

STUDENT FELLOWSHIPS COMMITTEE

Charge: To select the 1989–1990 recipients of American Accounting Association fellowship grants and to determine the amounts of these grants.

Chairperson: Lewis F. Davidson, Florida International University
A. Faye Borthick, University of Tennessee
Nabil M. A. H. Hassan, Wright State University

TEACHING/CURRICULUM DEVELOPMENT AWARD COMMITTEE

Charge: To select recipient(s) of the Outstanding Teaching/Curriculum Development Award using the criteria approved by the Executive Committee.

Chairperson: Bud Baskin, Arthur Andersen & Co.
Jack C. Gray, University of Minnesota
Zoe-Vonna Palmrose, University of Southern California
K. Fred Skousen, Brigham Young University
Harold M. Sollenberger, Michigan State University
Robert B. Sweeney, Memphis State University

TRUEBLOOD SEMINARS COMMITTEE

Charge: To assist Touche Ross & Co. in the continuing conduct of the Trueblood Seminars.

Chairperson: Richard J. Asebrook, University of Massachusetts
Andrew H. Barnett, San Diego State University
Thomas R. Craig, Illinois State University
Karen L. Hooks, University of South Florida

INFORMATION FOR AUTHORS—*Continued*

MANUSCRIPT PREPARATION AND STYLE

The Accounting Review's manuscript preparation guidelines follow the B-format of the *Chicago Manual of Style* (University of Chicago Press). Another helpful guide to usage and style is *The Elements of Style*, by William Strunk, Jr., and E. B. White (Macmillan Publishing Company). Spelling follows *Webster's International Dictionary*.

FORMAT

1. All manuscripts should be typed on one side of 8½ x 11" good quality paper and be double spaced, except for indented quotations.
2. Manuscripts should be as concise as the subject and research method permit, generally not to exceed 8,000 words in length.
3. Margins of at least one-inch from top, bottom, and sides should facilitate editing and duplication.
4. To assure anonymous review, authors should not identify themselves directly or indirectly in their papers. Single authors should not use the editorial "we."
5. A cover page should show the title of the paper, the author's name, title, and affiliation, any acknowledgements, and a footnote indicating whether or not the author would be willing to share the data (see last paragraph in this statement).

Pagination: *All* pages, including tables, appendices, and references, should be serially numbered. The first section of the paper should be untitled and unnumbered. Major sections may be numbered in roman numerals. Subsections should not be numbered.

Numbers: Spell out numbers from one to ten, unless when used in tables and lists, and when used with mathematical, statistical, scientific, or technical units and quantities, such as distances, weights, and measures. For example: *three days*; *3 kilometers*; *30 years*. All other numbers are used numerically. Generally when using approximate terms spell out the number, for example, *approximately thirty years*.

Percentages and Decimal Fractions: In nontechnical copy use the word *percent* in the text; in technical copy the symbol % is used. (See the *Chicago Manual* for discussion of these usages.)

Hyphens: Use a hyphen to join unit modifiers or to clarify usage. For example: a *well-presented analysis*; *re-form*. See Webster's for correct usage.

Key Words: The synopsis is to be followed by four *key words* that will assist in indexing the paper.

SYNOPSIS

A synopsis of about 500 words should be presented on a separate page immediately preceding the text. The synopsis should be nonmathematical and include a readable summary of the research question, method, and the significance of the findings and contribution. The style should be objective, without personal pronouns. The title, but not the author's name or identification designations, should appear on the synopsis page and on the first page of the text.

TABLES AND FIGURES

The author should note the following general requirements:

1. Each table and figure (graphic) should appear on a separate page and should be placed at the end of the text. Each should bear an arabic number and a complete title indicating the exact contents of the table or figure.
2. A reference to each graphic should be made in the text.
3. The author should indicate by marginal notation where each graphic should be inserted in the text.
4. Graphics should be reasonably interpreted without reference to the text.
5. Source lines and notes should be included as necessary.

Equations: Equations should be numbered in parentheses flush with the right-hand margin.

DOCUMENTATION

Literature citations are made according to the *Chicago Manual*, Chapter 15, "Documentation: References, Notes, and Bibliographies."

Citations: Work cited should use the "Author-Date System" keyed to the list of works cited in the Reference List (see below). Authors should make an effort at including relevant page numbers in the cited works.

1. In the text, works are cited as follows: authors' last name and date, without comma, in parenthesis: for example, (Jones 1987); with two authors: (Jones and Freeman 1973); with more than two (Jones et al. 1985); with more than one source cited together (Jones 1987; Freeman 1986).
2. Unless confusion would result, do not use "p." or "pp." before page numbers: for example, (Jones 1987, 115).
3. When the Reference List contains more than one work of an author, the suffix *a*, *b*, etc. follows the date in the text citation: for example, (Jones 1987a) or (Jones 1987a; Freeman 1985b).
4. If author's name is mentioned in the text, it need not be repeated in the citation: for example, "Jones (1987, 115) says. . . ."
5. Citations to institutional works should use acronyms or short titles where practicable: for example, (AAA ASOBAT 1966); (AICPA Cohen Commission Report 1977). Where brief, the full title of an institutional work might be shown in a citation: for example, (ICAEW *The Corporate Report* 1975).
6. If the manuscript refers to statutes, legal treatises, or court cases, citations acceptable in law reviews should be used.

Reference List: Every manuscript must include a list of references containing only those works cited. Each entry should contain all data necessary for unambiguous identification. With the author-date system, use the following format recommended by the *Chicago Manual*:

1. Arrange citations in alphabetical order according to surname of the first author or the name of the institution responsible for the citation.
2. Use author's initials instead of proper names.
3. Dates of publication should be placed immediately after author's name.
4. Titles of journals should not be abbreviated.
5. Multiple works by the same author(s) should be listed in chronological order of publication. Two or more works by the same author(s) in the same year are distinguished by letters after the date.

Sample entries are as follows:

American Accounting Association, Committee on Concepts and Standards for External Financial Reports. 1977. *Statement on Accounting Theory and Theory Acceptance*. Sarasota, FL: AAA.

Fabozzi, F., and I. Pollack, eds. 1987. *The handbook of fixed income securities*. 2nd ed. Homewood, IL: Dow Jones-Irwin.

Porcano, T. M. 1984a. Distributive justice and tax policy. *The Accounting Review*. (October): 619–636.

———. 1984b. The perceived effects of tax policy on corporate investment intentions. *The Journal of the American Taxation Association*. (Fall): 7019.

Sherman, T. M. 1984. *Conceptual framework for financial accounting*. Cambridge, MA: Harvard Business School.

Footnotes: Footnotes are not used for documentation. Textual footnotes should be used only for extensions and useful excursions of information that if included in the body of the text might disrupt its continuity. Footnotes should be double spaced, numbered consecutively throughout the manuscript with superscript Arabic numerals. Footnotes are placed at the end of the text.

SUBMISSION OF MANUSCRIPTS

Authors should note the following guidelines for submitting manuscripts:

1. Manuscripts currently under consideration by another journal or other publisher should not be submitted.
2. In the case of manuscripts reporting on field surveys or experiments, four copies of the instrument (questionnaire, case, interview plan, or the like) should be submitted.
3. Four copies should be submitted together with a check for $50.00 in U.S. funds made payable to the American Accounting Association. Effective January 1990, the submission fee is nonrefundable.
4. The author should retain a copy of the paper.
5. Revisions must be submitted within 12 months from request, otherwise they will be considered new submissions.

COMMENTS

Comments on articles previously published in *The Accounting Review* will be reviewed (anonymously) by two reviewers in sequence. The first reviewer will be the author of the original article being subjected to critique. If substance permits, a suitably revised comment will be sent to a second reviewer to determine its publishability in *The Accounting Review*. If a comment is accepted for publication, the original author will be invited to reply. All other editorial requirements, as enumerated above, also apply to proposed comments.

POLICY ON REPRODUCTION

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BOOK REVIEWS

Shane R. Moriarity, Editor

Editor's Note: Two copies of books for review should be sent to Professor Shane R. Moriarity, School of Accounting, University of Oklahoma, Norman, OK 73019. All of the reviews in this issue were commissioned by the prior editor, Richard P. Brief.

ANNE LOFT, *Understanding Accounting in its Social and Historical Context*, Foundations of Accounting Series (New York and London: Garland Publishing, Inc., 1988, pp. 316, $40.00).

This book represents a major contribution to the sociopolitical paradigm in accounting research which is emerging as an alternative to positivist mainstream accounting research. Mainstream accounting research is woefully behind the times compared to the intellectual strides that have been made in the other disciplines in the past decades. In history, philosophy, politics, psychology, sociology, and most of the social sciences, it has been recognized that reality is not simply described by "the facts" and revealed by "knowledge," but that the procedures and practices by which reality is described, theorized, discovered, and accounted for, play a part in constituting and reproducing reality. Even in physics and chemistry, it is old news that there is an interdependence between the observer and the observed. The myth that scientists objectively and noninteractively observe physical reality has long been exploded within the physical sciences.

The repercussions of these "discoveries" are now registering in accounting research, with gathering intensity. One could speculate as to the reasons why these movements in other disciplines have taken so long to be realized within the research domain of accounting. One reason would perhaps be that, as Loft discusses in this book, cost accounting (and one can say the same of financial and international accounting) has had the status of "the truth." Cost accounting "gave 'the facts'" (p. 243). When the phenomenon under observation is a set of social practices which have been historically depoliticized and legitimized by a discourse which maintains them as revealing "the facts" (see Chapter 7), then it is a major undertaking to re-politicize those practices. Loft's book significantly adds to a growing discourse which is aimed at re-socializing and re-politicizing accounting practices.

Chapter 1 discusses the Foucauldian conceptions of "knowledge," "power," and "truth" and the constitutive interplay of these. Chapter 2 incorporates these concepts into an analysis of cost accounting and management accounting practices. Cost and management accounting is seen as a "regime of truth," a recording and surveillance system which creates "visibilities" that is, the "truth" about people and their work. Meaningful parallels are drawn between cost accounting and Jeremy Bentham's "panopticism"—a mode of disciplinary control by which it was intended that the inmates of schools, prisons, workhouses, asylums, and factories would be subject to continual watching, control, and reform. Cost and management accounting achieves homogenization and "normalization" in a similar way, by recording and, thus, promoting certain behaviors and making visible certain categories of action, and by excluding others. As Loft states "the creation of a record is an act of power in itself" (p. 35). Cost and management accounting is described as a sophisticated disciplinary technique: "in the factory the power of the disciplinary techniques is not just seen in the fact that they enable power to be exercised over employees. It produces a set of characteristics which 'is' the employee—a unit of production with a measured amount of training, skills, and capacities. This power is exercised 'through' the employees, not simply over them" (p. 45). Accounting plays a part in creating human agency.

Chapter 2 also contains a very interesting discussion of the influence of accounting on the periodization, standardization, and commodification of time. Finally, the social process of professionalization is discussed.

The subtitle of this book is *The Case of Cost Accounting in Britain 1914–1925*, and chapter 3 presents a review of the development of cost accounting up to the beginning of this period, commencing with the industrial revolution in Britain from 1750 to 1840.

Chapter 4 deals with the First World War. During this period, the British government needed to control industry and to price munitions contracts where there was no clear market price and the government required most of the country's production. Loft describes how, in these circumstances, the cost accountants organized, differentiated themselves from others, promoted their social visibility, and extended their work.

Chapter 5 compares the post-war vision of reconstruction with the eventual "reality." It also describes the organizing of cost accountants, and their struggle to define their role and their social position, especially vis-á-vis the Chartered Accountants. Chapter 6 continues this analysis and deals with the issues of selecting members for the Institute of Cost and Works Accountants (ICWA) and the procedures by which members attempted to obtain occupational closure, and define their techniques, knowledge, work, and social position, especially contra engineers on the one hand, and on the other, cost clerks.

Chapter 7 describes how cost accounting was depoliticized, promoted, and legitimized by the social construction around it, by members of the ICWA, of a discourse claiming it to reveal the economic "facts" and the "true cost" in a "scientific" way.

Chapter 8 concludes this book which is an adaptation of Anne Loft's Ph.D. thesis. It summarizes the work and draws out important implications of the study.

In summary, this book is well-written and painstakingly researched, and is among the first of major, that is book-length, studies within the sociopolitical/social constructionist paradigm. It shows the importance of historical research to that paradigm, and also the contribution that a constructionist analysis can make to accounting history.

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J. ALEX MILBURN, *Incorporating the Time Value of Money Within Financial Accounting* (Canadian Institute of Chartered Accountants, 1988, pp. xv, 349, $42.50 Can. paper).

In the author's words, "The terms of reference of this study were to consider whether the cost-based accrual financial accounting model that is at the basis of existing GAAP can be significantly improved by a more systematic and comprehensive application of time-value-of-money principles" (p. 313). The approach is evolutionary, rather than revolutionary, but nevertheless implies significant revisions of GAAP.

The book is divided into six parts. The first two present a very sophisticated analysis of present value principles, and endorse the currently accepted "effective interest" method of accounting for monetary assets. This implies calculating an internal rate of return (IRR) when the asset is acquired, and making the rate of return on the asset equal the IRR every year. Even those of us who like to think that we know almost all there is to know about present value analysis will gain additional insights from reading these sections of the book.

Part III concerns accounting for operating assets, and centers around depreciation. The author argues that depreciation cannot be rational unless it is based on the future cash benefits which the asset is expected to generate. Furthermore, depreciation should be calculated so that the rate of return will be the same each year, if the pattern of benefits is as expected, as is the case with monetary assets. A major problem is to determine the pattern of future benefits, and the "appropriate" discount rate on future benefits. Both of these problems are discussed in considerable detail.

Part IV concerns accounting for liabilities. He endorses carrying liabilities at the present value of the expected future cash outlays. The thinking is parallel to the discussion of monetary assets in Part II.

Part V is concerned with income taxes. The overriding principle is that combined depreciation plus tax expenses should be calculated so that the return on investment will equal the "appropriate" rate each year, if the anticipated pattern of cash flows is observed. This can be done either by (1) making the tax expense equal the tax payment, and adjusting the depreciation to bring about the desired results, or (2) assuming a depreciation pattern, and adjusting the tax expense to yield the desired result. In the latter case, a deferred tax liability will arise if there is an excess of tax expense over tax paid. Accrued interest on the tax liability is included as a tax expense. The book value of the asset less the tax liability in case (2) is identical to the book value of the asset in case (1).

The final section considers additional steps which should be taken before these ideas can be implemented.

The argument concerning depreciation illustrates the flavor of the analysis. The FASB has said that the distinguishing characteristic of an asset is the expected future benefit. The present value of this future benefit is, therefore, the only attribute of an asset which accountants should measure. The other four attributes permitted by the FASB ("adjusted" historical cost, etc.) are inconsistent with the definition of an asset, and are inappropriate measurement attributes.

The FASB requires that depreciation be "systematic" and "rational." Depreciation is not rational unless it reflects the present value of future benefits. Accountants should, therefore, estimate the benefit pattern, and determine depreciation accordingly. Just as each benefit pattern implies a depreciation scheme, each depreciation scheme implies a benefit pattern. Current practice is to select depreciation arbitrarily from a set of "approved" procedures. This depreciation is unlikely to imply the anticipated benefit pattern, and, therefore, does not meet the "rationality" test.

It is really impossible to do justice to this work in a short review. While the unifying theme is the time value of money, anyone who is interested in accounting theory, or in improving the consistency of GAAP, will obtain new insights. The proposals are presented within a consistent framework of analysis, and implementation problems are explored extensively, although even the author recognizes that further study will be necessary.

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LEE D. PARKER, Editor, *Financial Reporting to Employees* (New York and London: Garland Publishing, Inc., 1988, pp. xv, 247, $35.00).

The objective of this book is "to introduce accountants and managers to a historical perspective of corporate financial reporting to employees" (p. xvii). It consists of a collection of 32 papers drawn from a wide variety of sources, written during the period from the early 1920s to the 1980s. Any work which sensitizes the contemporary researcher to the intellectual roots of current endeavors is to be applauded and this book succeeds admirably in conveying the enormous amount of interest this subject area has historically attracted.

The book is divided, necessarily somewhat arbitrarily, into seven sections covering such topics as reporting rationales, reporting methods, reporting practices, and assessing employee interest. It is at its best in showing that disclosure of accounting information to employees has in the past caught the imagination of commentators from different backgrounds and with different interests. Consequently, while the book contains contributions from practicing and academic accountants, there are also the views of company presidents, engineers, personnel managers, trade unionists, and even a public relations advisor. The papers have been collected from a wide range of professional, academic, and industrial sources published in the USA, the UK, and Australia.

Given the diverse backgrounds of the authors and the original publications and the wide time span covered (about 60 years) in the book, the reader might anticipate a rich heterogeneous mixture of views with some element of disagreement and controversy. This is not, however, the case. The underlying theme of many of the papers is that the reporting of accounting information to employees is in some way intrinsically desirable and that if done correctly employee morale and motivation can be improved and managerial control made easier. A substantial literature challenging the appropriateness of these assumptions has certainly existed since the 1970s (and indeed much earlier) and a better balanced book would have resulted from some inclusion of this work. It does not, in fact, even get a mention in the list of further readings.

The book makes little effort to guide the reader through the various papers, preferring instead to offer only general introductions to the material contained in each section. This is a reasonable approach, but one is often left with the impression that it would have been interesting to know why a particular paper had been selected for inclusion. The only attempt to provide any overview of the material is contained in the first paper co-authored by the editor of the book. This advances the proposition that a cyclical managerial interest in financial reporting to employees can be associated with periods when assorted environmental imperatives cause companies to feel in some way under pressure. Such a notion is clearly related to the "cycle of control theory" found in the sociology and industrial relations literature. It is perhaps significant that this "theory" has been subjected to increasing criticism in such areas as joint consultation and profit-sharing, as being an oversimplistic representation of a much more complex process. I suspect that the same is probably also true of the managerial disclosure of accounting information to employees.

Overall, this is a worthwhile book and should find its way into many libraries. It doesn't claim too much for itself, but instead offers the researcher a glimpse into a subject area which as the editor correctly notes is often wrongly viewed as a modern phenomenon.

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DAVID SOLOMONS, *Guidelines for Financial Reporting Standards* (London: The Institute of Chartered Accountants in England and Wales, 1989, pp. 77, paper).

David Solomons is one of our most distinguished accounting thinkers and writers. He was closely associated with the FASB in developing Statement of Financial Accounting Concepts No. 2, *Qualitative Characteristics of Accounting Information*. In the end, Solomons was disillusioned with the outcome of the FASB conceptual framework project. In a highly critical paper (Solomons 1986) he indicated his feeling that the Board had veered away from the conclusions to which it was logically forced by its work. In particular, he considered its capstone statement on *Recognition and Measurement in Financial Statements of Business Enterprises* a dismal failure.

The present work was commissioned by the Research Board of the English Institute and is addressed to the Accounting Standards Committee, the standard-setting body for the whole of the United Kingdom and Ireland. Its title—*Guidelines for Financial Reporting Standards*—is innocuous. But we should not be misled by the word "guidelines." This, albeit in a condensed form, is the conceptual framework that Solomons believes in.

Solomons is a believer in the need for accounting standards. He observes that, as a matter of history, accounting standards have developed in a haphazard manner through a process of firefighting. No doubt, he says, an implicit framework of ideas underlies decisions of standard-setters. Nevertheless, he argues an *explicit* framework would be useful to reinforce the underlying implicit ideas and highlight inconsistent and defective standards.

The flavor of the guidelines can best be conveyed by a summary of Solomons' principal propositions:

- Assets and liabilities are the fundamental material of financial statements. Revenues and expenses are merely names given to changes in these fundamental items. Therefore, adoption of the "Asset and Liability view" of profit determination will help preserve the integrity of financial reports.
- Accounting standards must be guided by the qualitative characteristics that are desired in information reported. Those characteristics are essentially the same as those set out in SFAC No. 2, with relevance and reliability taking pride of place. Interestingly, Solomons suggests that it may be productive to cease using the omnibus term "reliability" and talk rather in terms of its separate ingredients, namely, representational faithfulness, comprehensiveness, and verifiability.
- An asset, by definition, promises probable future economic benefit. If the promise is highly uncertain (the probability is small), the asset does not gain admission to the balance sheet. Equally there may be uncertainty about the measurement of the asset. If its magnitude cannot be measured and verified with reasonable certainty, that will also be grounds for its nonrecognition in the balance sheet. Similar statements may be made about liabilities. Thus, the joint criteria for recognition of an asset or liability in a balance sheet must be that it satisfies its basic definition *and* can be measured and verified with reasonable certainty.
- The accounting model embodied in financial statements should be selected based on relevance to as many as possible of the principal classes of users. On these grounds, an entity's assets and liabilities should be reported at their value to the going concern. Likewise, measurements should be stated in units of constant purchasing power so that a reported break-even over a period means that real financial capital has been maintained. Value to the business ("deprival value") is the preferred form of current value because net realizable value has the fatal deficiency that realizable values are irrelevant to assets specifically adapted to the needs of the particular business.

Conceptual framework studies inevitably tend to be rather bloodless documents. The skeleton is there, but the flesh and features are lacking. The appendices showing how Solomons' concepts would be applied are, therefore, a welcome addition. In addition, Solomons enlivens his paper with many cogent comments. Here is a sampling, largely in his own words but with editorial additions to make clear the context:

- The right test of the fitness of an accounting principle is not that it is "generally accepted" but that it "tells it like it is."
- "Sustainable income" is not an accounting concept. It is for the financial analyst to make his own estimate of "sustainable income" from the information that the accountant can provide.
- A new accounting standard that changes the way in which financial position or performance is presented rarely meets with universal approbation. There will usually be some interested group that fears that the new standard will have harmful economic consequences for it. . . . If the harmful consequences of a new standard are real, it will sometimes be because the interest that has been harmed was previously the beneficiary of some advantageous treatment. . . . Substituting a

level playing field for a slope that favors the down-hill team is precisely what accounting standard setting is all about.

- It is unrealistic to suppose that reliable cost-benefit calculations in the field of financial reporting will ever be possible.
- Prudence is a characteristic of persons, not of information. It does not belong in a list of fundamental accounting concepts.

Solomons' stated aim in this work is to present a coherent set of guidelines flowing from a few simple ideas. To avoid disruption of his flow of thought he did not indulge in extensive justification of his ideas or attempts to rebut contrary views. This may have been a necessary decision, given his goal. It does, however, leave the reader wondering how persuasive the work will be. In his preface, Solomons refers to "the controversial nature of some of my proposals." His point is emphasized by the inclusion of a disclaimer by his sponsors. I seemed to hear echoes of the 1962 Statement of the Accounting Principles Board when it washed its hands of the radical ideas contained in the accounting research studies by Moonitz and Sprouse and Moonitz, respectively.

As Solomons says: "It may be that no-one's views will be changed by . . . [these guidelines] . . . but at least it may be hoped they will raise the level of the debate." By this test the work is a success. However, it leaves open an even more urgent question: "What does it take to obtain the necessary degree of consensus to move ideas out of studies and into the world of action?" That is, what is needed if a conceptual framework is ever to be more than a rationalization of what accountants are doing? Will the English profession succeed where others have failed?

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REFERENCE

Solomons, D. 1986. The FASB's conceptual framework: An evaluation. *Journal of Accountancy.* (June): 114–124.

KYOJIRO SOMEYA, Editor, *Accounting Education and Research to Promote International Understanding: The Proceedings of the Sixth International Conference on Accounting Education* (New York; Westport, CT; and London: Quorum Books, 1988, pp. xv, 913, $75.00).

Interaction with colleagues is frequently the most beneficial aspect of academic conferences. The organizers of the Sixth International Conference on Accounting Education held in Kyoto, Japan in October 1987, stressed the objective of promoting international understanding and mutual respect amongst the participants. It would be difficult for any book to capture the interaction and spread of knowledge from such a meeting.

The proceedings from the conference are extensively recorded in this book. The relevance and quality of the papers and discussion are, not surprisingly, highly variable. Of particular interest to scholars of accounting practices and related education in foreign countries are short descriptive papers covering several countries. The most extensively covered countries include the People's Republic of China, with nine papers, Japan, and the United States of America. However, the breadth of countries covered is extensive and provides some insights into accounting practices of countries for which there is little readily available information. Some of the more unusual countries considered include: Finland, Nepal, New Zealand, Pakistan, the West Indies, and the Socialist Countries.

With few exceptions the papers are descriptive, loosely formulated, and seem to reflect the views of the relevant authors. Some authors (e.g., Berry and Graves, Burns and Gately, Alkagaji) use data from the 1970s which are of questionable relevance in the late 1980s. Other authors report new data from surveys but in most cases little detail is provided of the methodology of the research so that the results presented need to be accepted more or less on face value.

I came away from reading this voluminous work with the impression that many differences remain in accounting education and practices and will continue to do so for many years. While international harmonization and globalization is currently in vogue in many socio-economic and political fields, including accounting, the need and likely near-term success of this process is questionable. Of course, most international accounting scholars are already aware of these issues and will learn little from this book. For those unfamiliar with these issues, this book of proceedings provides some reasonable reference papers, but the ability to select those papers is severely hindered by the lack of a table of contents for the papers.

In sum, the book provides a few reasonable descriptive papers on international accounting practices and educational issues, but the book is much too large and it is difficult to make selections of papers of interest. Thus, it is likely to be of nostalgic interest to participants of the conference, but of little practical use to a broader readership.

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EDWARD STAMP, *Selected Papers on Accounting, Auditing and Professional Problems* (New York and London: Garland Publishing, Inc., 1984, pp. xxvi, 675, $80.00).

MICHAEL J. MUMFORD, Editor, *Edward Stamp: Later Papers* (New York and London: Garland Publishing, Inc., 1988, pp. xi, 115, $30.00).

Eddie Stamp was one of a vanishing breed: an accounting academic who had a deep and abiding concern for the performance of the accounting profession. These two volumes, the first edited by Stamp himself in 1984 containing about 700 pages, and the second edited posthumously by Michael Mumford in 1988 and running about 125 pages, collect most of Stamp's articles and shorter pieces written during his 23 years as an academic. He died in January, 1986.

Stamp took a First Class Honours degree in natural sciences at Cambridge, and emigrated to Canada, where he became a chartered accountant. He practiced for 12 years and was admitted to the partnership in one of Canada's leading accounting firms. But life as a practitioner, where the motto was "to give service to the client," was frustrating. Stamp despaired at the "multiple options available to management in choosing how to report to shareholders" and at the failure of conventional accounting to portray economic reality. Yet, as a member of a firm, he was required to clear his views with his partners. He yearned for the intellectual freedom of university life, where he could write and speak without constraint. Intellectual freedom won out, and he left Canada at age 34 to launch an academic career in New Zealand. In his third year in acadème, he wrote a series of 23 pungent critiques in a Wellington newspaper, assailing some of New Zealand's leading companies (including the newspaper's publisher) for the lack of informativeness of their annual accounts. Gentle New Zealand was the first to learn that Eddie Stamp had become an academic!

After five years in New Zealand, Stamp moved to a chair at the University of Edinburgh, where he crossed swords with the elders of the Scottish profession. Then, in 1969, when accounting principles were being criticized in the British press for their lack of definition and firmness, Stamp accepted an invitation from *The Times* to lend his authority to the chorus of complaints. To everyone's surprise, the President of the English Institute, in an unprecedented act of public display, rose to the profession's defense in a column in the same newspaper. This public exchange of diametrically opposed views provoked concerns in many quarters, including the Government, over the credibility of financial reports. In December, 1969, the English Institute, in a surprise announcement, informed the world that it was adopting a totally new program for approving accounting standards. No one doubts that Stamp's column in *The Times* precipitated this dramatic reform by the largest and most influential accountancy body in the British Isles. It was his finest hour.

In 1971, Stamp took up a chair at the University of Lancaster and became director of the International Centre for Research in Accounting, which had been established expressly for him with the pivotal support of the very president of the English Institute who had been his adversary in the pages of *The Times* less than a year before.

As a speaker and author, Stamp sallied forth on inflation accounting, the independence of the profession, the standard-setting process, international harmonization, accounting education, the conceptual framework, and research methodology. He addressed several of these subjects on his American tour as the American Accounting Association's Distinguished International Visiting Lecturer in 1977. He was perhaps the most influential member of the working group that prepared *The Corporate Report*, a study that was commissioned, and then ignored, by the Accounting Standards Steering Committee. At the invitation of the Canadian Institute of Chartered Accountants, he composed a Canadian conceptual framework for which he received scant credit from the commissioning body.

What does the reader gain from these collections? Eddie's work shines brightest when he trains his keen analytical eye on major accounting cases and controversies, such as the Reid Murray Affair and the Atlantic Acceptance Report. He is also at his best in the comparisons which he frequently draws among the accounting environments in the several countries whose cultures and institutions he understood so well. Whether comparing the Scots with the English, the Canadians with the Americans, the Australians with the New Zealanders, or the Americans with the British, Eddie produces penetrating insights that few other writers can approach.

Above all, these essays are marked with the fervor of a strong personality, in stark contrast to the dispassionate inquiries that have marked our literature in the past two decades. Eddie sought to make an impact, to be an agent of change. Unlike academics who are content with the published article, Eddie craved to see the effect of his writings in the world of affairs.

The range of Eddie's writings is impressive. He was a progressive spirit in a reactionary profession, and throughout his writings he reminded accounting professionals and academics of their public responsibilities. The principles to which Eddie subscribed can best be found in his Inaugural Address, "A Noble State of Tension," which he delivered in 1966 upon the occasion of his appointment to an accounting chair in New Zealand. He said that "it is one of the most important functions of the academic to subject his environment to a critical analysis and to come forth with constructive proposals to remedy the faults that he sees" (B 1, p. 10). Eddie devoted his academic life to this mission.

One hopes that someday it might be possible to publish excerpts from his extensive correspondence. Judging from my many exchanges with Eddie, I should guess that he left bulging file drawers of fascinating letters. He was an indefatigable and insistent correspondent, with an insatiable curiosity. An envelope in the morning mail with a Lancaster postmark could mean that Eddie was taking off against someone, and perhaps against the one to whom the letter was addressed. In many of his letters, he would propound one or more interrogatories, and he expected full answers by return mail!

These volumes are a fitting testament to the valued contributions of an important accounting academic and a treasured friend. My only misgiving is the omission of the complete bibliography of Eddie's writings.

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GEORGE J. STAUBUS, *Activity Costing for Decisions* (New York and London: Garland Publishing, Inc., 1988, pp. xxix, 255, $35.00).

This book, intended for management/cost accounting educators and researchers, is an enhanced version of *Activity Costing and Input-Output Accounting* originally published in 1971 by Richard D. Irwin. The enhancement is provided by a series of short papers prepared by the author.

In the first paper and introduction, "Episodes in the Development of Decision Usefulness and Activity Costing," Staubus comments on the historical development of the decision usefulness theory of accounting, his contribution to the direct costing/full costing controversy, and his efforts to advance accounting for the cost of capital.

Activity Costing and Input-Output Accounting (previously reviewed in the October 1971 issue of *The Accounting Review*) is reproduced in its entirety in the next 160 pages. Here Staubus attempts to develop a theory of cost accounting placed within the overall context of financial reporting. The emphasis is on costing for planning and control in manufacturing organizations. The central thesis is best summarized by a quote from Chapter 5:

> The accountant's chances for a fairly general degree of success in providing useful cost information depend upon his maintaining a diversified inventory of building blocks in the form of up-to-date standard unit costs of relatively narrow activities. This permits him to assemble a reasonably relevant combination of data for whatever need may arise. This is the essence of activity costing (pp. 77–78).

Consistent themes throughout the ten chapters of this reprinted book include: the definition of cost as an economic sacrifice; the need for detailed accounting for acquisition and holding costs; treating holding costs, including the cost of equity capital, as part of the cost of activities performed using assets; the inadequacy of using only three manufacturing cost elements (direct materials, direct labor, and overhead); and developing multiple activity cost rates for various levels of activity.

Following the reprint are several short works. The first consists of some errata, notes, and cross-references to other papers in the book. Next comes "The Dark Ages of Cost Accounting: The Role of Miscues in the Literature," (originally published in the Fall 1987 issue of *The Accounting Historians Journal*). Staubus places a portion of the blame for the current state of cost accounting on J. M. Clark's emphasis on different costs for different purposes, Paton and Littleton's difficulty in clarifying the cost concept, the American Institute of Accountant's definition of depreciation, the direct/variable costing literature, and the rejection of allocation in academic literature.

In "Activity Costing: New Subject for the Business School Core," Staubus proposes that "cost accounting teachers and textbooks present and suggest applications of a set of costing principles based on microeconomic theory and the decision-usefulness theory of accounting and consistent with the theory of finance" (p. 190). He also calls for the use of a conceptual framework for product costing and a shift from products to activities as the primary objects of costing. Other points raised in this and the last two papers update the reprinted book and reiterate points Staubus believes important.

I recommend this book, as well as the previous review published in 1971, to researchers and teachers interested in managerial/cost accounting. The original work was clearly ahead of its time and, perhaps, unfairly criticized in the *Review* for developing a cost rather than a value based accounting system. The early review likely reflected the influence of then recently published tomes by Chambers and Edwards and Bell.

In some ways the book may still be ahead of its time. We still do not have a uniform definition of cost, recorded holding costs do not include the cost of capital, and most organizations continue to use three manufacturing cost elements, although this is changing. I am not so sure of the desirability of some other recommendations.

The suggestion that the accountant's job is to develop multiple activity cost rates that are dependent on utilization seems difficult to implement even in this computerized era. The recommendation that the activity rates charged all users increase as utilization nears capacity may place an undesirable amount of unpredictability into a system used for planning and control. Staubus' response is that teachers should lean toward high-benefit systems, "leaving it to the graduate practitioner on the job to make the ultimate cost/benefit comparison" (p. 202).

While providing a cost accounting theory that emphasizes activity costing, the book does not provide specific guidance regarding the operation of an activity cost system in a complex multiple product/service environment containing many support activities. Chapter 8 of the original book does attempt to develop an example of an input/output activity model for a two product company with two raw materials, a single wage rate, and other cost factors. I found the example unrealistically simple yet difficult to follow because a number of assumptions were not clearly stated. I certainly would not want to try and explain it in class. Readers interested in useful examples of the operation of activity cost systems will have to look farther in the current literature or await the publication of the next edition of their favorite management accounting or cost accounting text. In the meantime, this work will provide insights into the "roots" of activity costing.

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STEPHEN A. ZEFF, Editor, *The US Accounting Profession in the 1890s and Early 1900s*, Foundations of Accounting Series (New York and London: Garland Publishing, Inc., 1988, pp. xxii, 585, $70.00).

The way the profession organized itself in the 1890s and early 1900s is the primary thrust of the collection of papers found in this book. There are also four papers on early U.S. accounting education. The papers are either recollections from some of the early practicing accountants on their efforts to organize the profession, or they are historical studies of this early period. Professor Zeff's purpose in collecting this material is to assist researchers to gain easier access to a "fragmented" literature.

The editor gives a short introduction to each of the authors which enables the papers to be put in context. This is both helpful and needed as some of the papers are chapters which have been extracted from particular books. Also included in the introduction is some useful bibliographic information on the histories of state societies of Certified Public Accountants, early histories of the major accounting firms, histories of early prominent accountants, and histories of accounting departments and the professional accounting fraternity (Beta Alpha Psi) at U.S. universities.

The recollections and histories from early practicing accountants are from Anyon (1925), Wilkinson (1904, 1927, 1928), Reckitt (1953), Webster (1941, 1944, 1944), and Sutherland (1969). These papers provide interesting insights into the early development of the profession and are important source material for some of the other historical studies in the book. The remaining historical studies are all done by academics with the exception of Carey (1969) who worked at the American Institute of Certified Public Accountants. The contributions from academics include Littleton (1942), Edwards (1954, 1955), Murphy (1966), and Previts and Merino (1979). These collected papers describe the early development of the accounting profession in terms of the stages of development passed through in order to be finally recognized as a profession. They highlight the way dedicated individuals, particularly in New York, Illinois, and Philadelphia, organized themselves into professional associations; how they transformed themselves from mere "men of figures" into professional accountants; how they sought to establish accounting as a subject worthy of teaching in the universities; how they obtained professional certification from individual states; how they attempted to define and standardize accounting knowledge and practice; how they had a tendency toward monopolization of skill and closure of ranks; and how they developed an ethic of integrity, confidentiality, and disinterestedness.

These stages of professionalization are interpreted in these papers as the outcome of responding to free market forces based on the underlying assumption that only those occupations which manage to constitute and control a market for their expertise become professions. Insights into this struggle can be found in these papers. However, most of the papers (with the exception of Previts and Merino) take an accounting-centered approach to their histories and do not refer to any great extent to the social, political, and economic context of this professionalization project. Consequently, the histories tend to be functionalist, ahistorical, and tend to legitimize the practices and social status of contemporary accountants.

This history of the accounting profession in the U.S. can be enriched by turning to social theory for help with the task of ordering the available data and making the sources speak more clearly. Alternative approaches that pay attention to the inegalitarian, corporate, and castelike aspects of the accounting profession, will not only provide alternative perspectives on the emergence of the accounting profession in the U.S. but also provide important insights into the social, economic, and political contexts of accounting. This kind of research will also provide insights into questions raised in these collected papers such as:

1. What was the nature of the conflict between the British and U.S. accountants?
2. What was the relationship of the state and the accounting profession?
3. How did the accountants shed their bookkeeper image?
4. What was the nature of the conflict between the New York accountants and accountants from other states?

This book is a welcome addition to the literature. The papers collected provide a good introduction and background for researchers seeking to understand the early organization of the profession in the U.S. and it is worth noting Professor Zeff's comment in the introduction that "many facets of this early development are yet to be investigated" (pp. xv–xvi).

ROSS E. STEWART
Associate Professor of Accounting

Seattle Pacific University

BOOKS RECEIVED APRIL 1, 1989 TO JULY 24, 1989

RAJ AGGARWAL and CHARLES H. GIBSON, *Discounting in Financial Accounting and Reporting: Issues in the Literature* (Morristown, NJ: Financial Executives Research Foundation, 1989, pp. 141, $6.00 paper).

SARAH BALL, *Directory of International Sources of Business Information* (London: Pittman Publishing, 1989, pp. vi, 698, £65.00).

VINOD B. BAVISHI, *International Accounting and Auditing Trends* (Princeton: Center for International Financial Analysis & Research, Inc., 1989, pp. 1332 in two volumes, $295.00).

AHMED BELKAOUI, *Behavioral Accounting: The Research and Practical Issues* (New York: Quorum Books, 1989, pp. xii, 178, $45.00).

AHMED BELKAOUI, *Human Information Processing in Accounting* (New York: Quorum Books, 1989, pp. xii, 298, $49.95).

E. W. BRODY, *Professional Practice Development: Meeting the Competitive Challenge* (New York: Praeger Publishers, 1989, pp. xi, 261, $45.95).

LAWRENCE D. BROWN, JOHN C. GARDNER, and MIKLOS A. VASARHELYI, *Accounting Research Directory: The Database of Accounting Literature*, Second Edition (New York: Markus Wiener Publishing, Inc., 1989, pp. iv, 583, $49.00).

CONNIE BRUCK, *The Predator's Ball* (New York: Penguin Books, 1989, pp. 399, $8.95 paper).

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COOPERS & LYBRAND, *Retiree Health Benefits: Field Test of the FASB Proposal* (Morristown, NJ: Financial Executives Research Foundation, 1989, pp. 215, $7.00 paper).

MORTIMER A. DITTENHOFER, *A Study of Legislation and Regulation of Internal Auditing in Selected Governments* (Fayetteville, AR: University of Arkansas, 1988, pp. xvi, 67, $10.00 paper).

M. MANFRED FABRITIUS and WILLIAM BORGES, *Saving the Savings and Loan: The U.S. Thrift Industry and the Texas Experience, 1950–1988* (New York: Praeger Publishers, 1989, pp. xiii, 161, $37.95).

MARYANN KELLER, *Rude Awakening: The Rise, Fall and Struggle for Recovery of General Motors* (New York: William Morrow and Company, Inc., 1989, pp. 246, $19.95).

CARRIE A. MEYER, *Land Reform in Latin America* (New York: Praeger Publishers, 1989, pp. xvi, 143, $37.95).

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HOWARD O. ROCKNESS and ROBERT W. ZMUD, *Information Technology Management: Evolving Managerial Rules* (Morristown, NJ: Financial Executives Research Foundation, 1989, pp. 132, $7.00 paper).

GARY ROSS, *No Limit: The Incredible Obsession of Brian Molony* (New York: William Morrow and Company, Inc., 1989, pp. 301, $18.95).

STANLEY C. W. SALVARY, *An Analytical Framework for Accounting Theory* (Fayetteville: University of Arkansas, 1989, pp. xiv, 121, $10.00 paper).

DONALD M. SCHINDEL, *Estate Administration and Tax Planning for Survivors* (New York: Garland Law Publishing, Inc., 1988, pp. 750, Looseleaf, $86.50).

SUNIL KUMAR SENGUPTA, *Accounting Perspective of Development Rebate—An Incentive Towards Industrial Growth in India* (Calcutta: Amukherjee & Co. Pvt. Ltd., 1988, pp. viii, 93, x, Rs 90.00).

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J. DAVID SPICELAND and SURENDRA P. AGRAWAL, *International Guide to Accounting Journals* (Markus Wiener Publishing, Inc., 1988, pp. ii, 292, $34.50).

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BASIL S. YAMEY, *Art & Accounting* (New Haven, CT: Yale University Press, 1989, pp. viii, 157, $45.00).

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JANUARY 1990 PLACEMENT ADS

The deadline for information to be included in the "Placement Information" section is two months prior to the date of publication. The REVIEW *is published on the first day of January, April, July, and October. Placement advertising and replies should be sent to the American Accounting Association, 5717 Bessie Drive, Sarasota, FL 34233-2399. ATTENTION: ADVERTISING DEPT. All replies to box numbers should be on separate sheets to facilitate forwarding. There is no charge for this service to AAA members and associate members seeking employment. Others will be charged a fee of $150 per insertion. ADS SHOULD NOT EXCEED 150 WORDS.*

#101 UNIVERSITY OF NEW ORLEANS invites applications for the position of Assistant, Associate, or Professor of Accounting in systems and/or managerial. Candidates should have the Ph.D. or DBA degree (accounting major). Individuals must have an established record of scholarly research and a commitment to quality teaching. Salary is negotiable and competitive. The University offers the M.S. in Accounting and the M.S. in Accounting (tax option), as well as the M.B.A. Approximately 550 undergraduate accounting majors are enrolled. The University has AACSB accreditation at both the graduate and undergraduate levels. Candidates should send resumé to: Professor Gordon A. Hosch, Chairman, Department of Accounting, College of Business Administration, University of New Orleans, New Orleans, LA 70148. UNO is an Affirmative Action, Equal Opportunity Employer.

#102 THE UNIVERSITY OF MICHIGAN-FLINT has openings for tenure-track faculty positions at all ranks starting in either September or January. Most interest areas can be accommodated, although preference will be given to candidates in auditing and accounting information systems. Professional certification is desirable. Responsibilities include quality teaching, research, and service. Candidates must have a doctorate or be in the last stages of ABD. Salary is competitive and fringe benefits are excellent. Candidates should send a resumé to: Dean Richard W. Fortner, School of Management, The University of Michigan-Flint, Flint, MI 48502-2186. Applications accepted until position is filled. AA/EOE.

#103 SUFFOLK UNIVERSITY, Boston, MA. The Accounting Department, School of Management, anticipates a FT tenure-track position opening, effective Fall 1990, at UG/G levels in managerial and/or financial areas with secondary interests in AIS or auditing. A PhD/DBA in Accounting and evidence of effective teaching, research, and a strong record of publication are required; CPA, CMA, and/or other certification(s) required. The UG/G business programs offered by the School are accredited by AACSB. For information, contact Professor Morris McGinnis, Chairperson of Accounting. (617) 573-8341. Submit application/academic vita to: Ronald Sundberg, Associate Dean, School of Management, Beacon Hill, Boston, MA 02108. (617) 573-8301. An equal opportunity, affirmative action employer.

#104 CALIFORNIA STATE UNIVERSITY, SACRAMENTO has accounting faculty openings, effective August 1990, in it's accredited AACSB undergraduate and master programs. Salary and rank are open. For tenure-track positions, applicants must hold a doctoral degree with specialization in accounting, or ABD with expectation of completion within the first semester of appointment. Candidates must complete all degree requirements by February 1, 1992 for continuation of appointment. Professional experience, a current record of scholarly activity, and/or certification are desirable. Primary emphasis is on teaching effectiveness; research and scholarly activities are required. Visiting professors must hold a doctoral degree with specialization in accounting and have extensive academic experience with a current record of scholarly activity or extensive professional experience. Send application letter and resumé to: Eugene Sauls, Chair, Department of Accountancy, School of Business Administration, California State University, Sacramento, Sacramento, CA 95819-2694. The Department will begin to review applications on September 30, 1989 until each position is filled. The closing date for applications is March 1, 1990.

#105 UNIVERSITY OF MARYLAND AT COLLEGE PARK invites applications for faculty positions in Accounting. The minimum qualification for Assistant Professor is a Ph.D. degree. A candidate for Associate or Full Professor should have a distinguished publication record and a record of quality teaching. Interested candidates should send resumés to: Professor Martin P. Loeb, College of Business and Management, University of Maryland at College Park, College Park, MD 20742. The University of Maryland is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

#106 GEORGETOWN UNIVERSITY, Washington, D.C. The school of Business Administration invites applications for a tenure-track position in Tax accounting for Fall 1990. Candidates should have a strong commitment to excellence in teaching and research. Salary and fringe benefits are competitive. The School of Business Administration offers the B.S.B.A. degree, with a concentration in Accounting. On the graduate level, Georgetown University offers programs leading to the degrees of Master of Business Administration and Master of Science in Taxation. Georgetown University is an equal opportunity/affirmative action employer. Please send resumé and references to: Virginia N. Flavin, Director of Faculty Services, School of Business Administration, Georgetown University, Washington, D.C. 20057.

#107 UNIVERSITY OF NORTH TEXAS is seeking applicants for expected accounting faculty positions for the 1990–1991 year. All positions are tenure-track. Minimum qualifications: Ph.D. or DBA in Accounting (ABD considered if dissertation in process). Undergraduate and graduate-level teaching. Salary is competitive. Send resumé to: Teddy L. Coe, University of North Texas, Department of Accounting, P.O. Box 13677, Denton, Texas 76203-3677. UNT is an Equal Opportunity, Affirmative Action Employer.

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#109 RETIRED PROFESSOR, 63, MBA/CPA, 34 years teaching experience, all at same university. Interested in temporary part-time or full-time position for a semester or short courses of a few weeks in introductory or cost classes. Warm climate preferred, but not absolutely essential.

#110 FROSTBURG STATE UNIVERSITY seeks applicants for Assistant/Associate Professor tenure-track position in Accounting available Fall 1990. Undergraduate teaching, student advising, community involvement and/or research. ABD in Accounting with firm completion date required. Ph.D. in Accounting, professional certification, practical and teaching experience preferred. Application review/selection process began October 16, 1989. APPLICATIONS ACCEPTED UNTIL POSITION FILLED. Send letter of interest, resumé, and the names, addresses, and telephone numbers of three references (for contact) to: Mr. C. Douglas Schmidt, Director of Personnel Services, Frostburg State University, Frostburg, Maryland 21532. AA/EOE.

#111 CHAIRPERSON ACCOUNTING DEPARTMENT: The University of Arkansas at Little Rock invites applications for Chairperson of Accounting beginning Fall Semester 1990. An established record of effective classroom teaching, professional service, and scholarly publications required, sufficient for appointment to Associate Professor or Professor. Salary competitive with comparable AACSB schools; fringe benefits include 10 percent University matching of TIAA/CREF employee contributions. Send letter of application to: Dr. Robert C. Culpepper, Dean, College of Business Administration, University of Arkansas at Little Rock, 2801 South University Avenue, Little Rock, Arkansas 72204. Applications will be subject to inspection under the Arkansas Freedom of Information Act. The University of Arkansas at Little Rock is an affirmative action, equal opportunity employer and actively seeks the candidacy of minorities and women.

#112 SAN JOSE STATE UNIVERSITY invites applications for tenure-track and temporary appointments in accounting. The areas of greatest need are accounting information systems and taxation. In evaluating applications, strong preference will be given to candidates who: demonstrate a record of teaching excellence; possess an appropriate doctorate from an AACSB-accredited university (applicants for temporary appointments must possess an MBA or its equivalent); have a record of, and continuing interest in, research and publications; possess professional certification; have shown an ability to work as part of a team; and have excellent communication and interpersonal skills. Salary and rank dependent upon qualifications. Application review will continue until suitable candidates are found. Please contact: Tom Black, Chair, Accounting Search Committee, Department of Accounting & Finance, School of Business, San Jose State University, San Jose, CA 95192-0066. Telephone (408) 924-3467 or (408) 924-3460. SJSU is an Equal Opportunity/Affirmative Action Employer.

#113 YALE UNIVERSITY SCHOOL OF MANAGEMENT. Yale's graduate School of Management is seeking a number of faculty members at the junior and senior level in the area of Accounting. Ph.D. or equivalent is required, research and teaching interest in application and theory preferred as well as interdisciplinary orientation. Appointments will be made for the 1990–1991 academic year. Please send resumé, references, and an example of scholarly work, by January 31, 1990 to: Michael E. Levine, Dean, Faculty Recruiting, Yale School of Management, Box 1A Yale Station, New Haven, CT 06520-7368. Yale is an equal opportunity, affirmative action employer.

#114 UNIVERSITY OF MIAMI. The department of accounting has openings for faculty at the assistant or associate levels. Applicants for the latter rank should have a demonstrated record of excellence in research and teaching while assistant level applicants should show promise of excellence. ABD applicants nearing completion will be considered. We are an equal opportunity employer. Contact: Professor Paul Munter, School of Business, University of Miami, P.O. Box 248031, Coral Gables, FL 33124.

#115 THE UNIVERSITY OF ARIZONA'S DEPARTMENT OF ACCOUNTING invites applications for Assistant, Associate, or Full Professors of Accounting. Visiting positions are also available at all ranks. Applicants for Assistant rank should possess a Ph.D. or be nearing completion. Advanced rank applicants must possess an earned doctorate and an established record of recent and continuing research and quality teaching. All tenure-track applicants must be committed to a continuing research program. This announcement will remain open until the positions are filled. Send vita to: Professor Andrew D. Bailey, Jr., Head, Department of Accounting, College of Business, The University of Arizona, Tucson, AZ 85621. The University of Arizona is an equal opportunity educator/employer, encouraging applications from women and minorities.

#116 THE UNIVERSITY OF NEBRASKA-LINCOLN School of Accountancy anticipates two tenure-track Assistant Professorships for Fall 1990. Requires Doctorate. Professional certification desirable. Must have interest in research and be willing to maintain an active involvement in accounting programs at the undergraduate, Master, and Doctoral levels. Send resumé, dissertation proposal, and references by April 2, or until qualified candidates apply thereafter to: Dr. James F. Brown, Jr., Recruiting Coordinator, School of Accountancy, University of Nebraska-Lincoln, Lincoln, Nebraska 68588-0488. Affirmative Action/Equal Opportunity Employer.

#117 TWO TENURE-TRACK OPENINGS FOR FALL 1990. One opening is for a person to teach managerial accounting at the undergraduate and MBA levels. The second position is for a person to teach financial accounting at the undergraduate and MBA levels. D.B.A. or Ph.D. in accounting required, although candidates that are A.B.D. will be considered for a Lecturer appointment. Previous university teaching experience or publications are not required, but preference will be given to those with experience that documents their ability to do quality teaching and research. The teaching load is three courses (nine semester hours), usually on two days per week. Research and publication are expected. Send letter of application, resumé, copies of graduate and undergraduate transcripts, evidence of teaching ability, and three letters of reference by January 15, 1990. The screening of candidates will begin shortly after January 15, 1990, with the position remaining open until filled. IUSB is an AA/EEO employer that actively seeks minority and female applicants. CONTACT: Dr. Paul A. Joray, Chairman, Division of Business and Economics, Indiana University at South Bend, P.O. Box 7111, South Bend, IN 46634.

#118 FACULTY POSITION, GRAND VALLEY STATE UNIVERSITY, F. E. Seidman School of Business. The Department of Accounting & Taxation is seeking to fill a tenure-track position beginning September 1990 in Accounting with interests in Financial, Auditing, and/or Tax. Faculty are expected to teach at the undergraduate and graduate levels. Appropriate Ph.D. required. Salary is competitive with excellent fringe benefits and summer teaching opportunities. The Grand Rapids metropolitan area, second largest in Michigan, provides excellent opportunities for research and consulting. Applications will be accepted until the position is filled. Apply to: Dr. Stanton C. Lindquist, Chairman, Department of Accounting & Taxation, F. E. Seidman School of Business, GRAND VALLEY STATE UNIVERSITY, Allendale, MI 49401. (616) 895-2163 or (616) 895-2167. An Equal Opportunity and Affirmative Action Employer.

#119 CENTRAL MICHIGAN UNIVERSITY has one faculty opening for the 1990-1991 academic year. The position is in the cost/managerial area at the rank of asistant or associate professor. Ph.D. or near completion is required; professional certification is desirable. Competitive salary with excellent benefits. Maximum of nine-hour load per semester; summer teaching and research opportunities available. Excellent working and living environment. The School of Business Administration possesses AACSB-accreditation and the undergraduate accounting program is accredited. Contact: Philip L. Kintzele, Chairman, Department of Accounting, Central Michigan University, Mt. Pleasant, MI 48859. CMU is an AA/EO institution; all parties are invited to apply.

#120 WAYNE STATE UNIVERSITY, Department of Accounting, invites applications for tenure-track positions as Assistant or Associate Professor. Earned doctorate required (those completing dissertation will be considered for Lecturer positions). Evidence of excellence in teaching, research, and professional activities is necessary. Candidates will be expected to teach undergraduate and graduate classes in Auditing, Financial, Cost, Tax, or Data Base Information Systems. The School of Business Administration is accredited by AACSB. Wayne State University is an affirmative action/ equal opportunity employer. Respond to: Dr. Alan Reinstein, Chairman, Department of Accounting, School of Business Administration, Wayne State University, Detroit, MI 48202. (313) 577-4530.

#121 THE UNIVERSITY OF ALABAMA Culverhouse School of Accountancy has openings for accounting faculty, beginning August 1990. Applicants will be considered at all ranks, including permanent and visiting, tenure-track, and temporary. Applicants for tenure-track positions should possess a doctorate or be in the final stages of a doctoral program and should demonstrate potential for quality research. Enquiries should be sent to: Robert W. Ingram, Director, Culverhouse School of Accountancy, Box 870220, University of Alabama, Tuscaloosa, AL 35487. An Equal Opportunity, Affirmative Action Employer.

#122 SAMUEL CURTIS JOHNSON GRADUATE SCHOOL OF MANAGEMENT, CORNELL UNIVERSITY. Position Opening—Accounting: Assistant, Associate, or Full Professor of Accounting. Responsible for teaching basic and advanced courses in accounting at the Master's level; research in area(s) of expertise and interests; supervision of doctoral candidates; and interdisciplinary contribution to the research and teaching of other faculty members. Direct inquiries to: Professor Dale Morse, S. C. Johnson Graduate School of Management, 520 Malott Hall, Cornell University, Ithaca, New York 14853. Applicants should have completed a doctorate or be at the dissertation stage of a doctoral program. Applications should include a vita, together with a dissertation proposal or abstract, and copies of research papers. An Affirmative Action/Equal Opportunity Employer.

#123 THE UNIVERSITY OF TEXAS AT DALLAS-ACCOUNTING. The School of Management at the University of Texas at Dallas has a tenure-track position available in Accounting beginning September 1, 1990. We are looking for an Associate or Full Professor, salary is open. A. Ph.D. from a research-oriented institution and evidence of scholarly research potential is required. Applications are especially welcome from scholars interested in Accounting. Applicants should send a complete curriculum vita, including background, experience, research and publications, and references (indication of sex and ethnicity for Affirmative Action statistical purposes is requested but not required) to: The University of Texas at Dallas, Academic Search #4001, P.O. Box 830688, M.S. AD 1.1, Richardson, Texas 75083-0688. The Search will close February 15, 1990, or when position is filled. The University of Texas at Dallas is an affirmative action/equal opportunity employer.

#124 THE UNIVERSITY OF MARYLAND European and Asian Divisions seek excellent teachers for undergraduate courses on U.S. military bases overseas. Minimum requirements include a master's in accounting, one year of recent college teaching experience, and U.S. citizenship. Renewable annual appointments begin August 1990. Excellent for a sabbatical or leave of absence. Benefits include transportation and military base privileges. Frequent travel and the cost of schooling make these positions difficult for those with children. Send resumé to: Dr. Ralph E. Millis, The University of Maryland University College, College Park, MD 20742-1642. AA/EEO.

#125 GEORGE WASHINGTON UNIVERSITY, School of Government and Business Administration, Department of Accountancy is seeking candidates for the newly created Benjamin Franklin Professorship in Accountancy. Candidates should have demonstrated significant scholarly accomplishments in the field of accounting or taxation; have a demonstrated record of research and teaching excellence; be willing to serve as a resource for faculty and students; have demonstrated an ability and willingness to be actively involved in the business community through educational programs and research; and have a terminal degree in Accounting or Taxation. Applications and Nominations should be sent to: Professor Joseph Hilmy, Ph.D., Search Committee, Benjamin Franklin Professor of Accountancy, The George Washington University, School of Government and Business Administration, Hall of Government, Room 209, Washington, DC 20052. The selection process will begin on February 1, 1990, and will conclude when the position is filled. The George Washington University is an Affirmative Action/Equal Employment Opportunity Employer.

#126 THE UNIVERSITY OF NEBRASKA AT OMAHA invites applicants for tenure-track positions in accounting. Interest areas are financial, managerial, and tax. Rank and salary commensurate with qualifications. An earned doctorate (ABD considered) and potential for scholarly research, teaching, and professional service activities are expected; professional certification desirable. The department offers both MPA and undergraduate programs. Applications accepted until positions are filled. Contact: Professor Michael J. Barrett, Chair, Professional Accounting Department, College of Business Administration, The University of Nebraska at Omaha, Omaha, Nebraska 68182-0047. (402) 554-2807. AACSB-accredited. Equal Opportunity/Affirmative Action Employer.

#127 THE UNIVERSITY OF CALGARY FACULTY OF MANAGEMENT invites applications for positions available in the areas of taxation, auditing, financial, and managerial accounting. Candidates should have a PhD or DBA with a major in accounting. DBAs in advanced dissertation stage will be considered. Computer assistance and research support are available. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Calgary has an Employment Equity Program and encourages applications from all qualified candidates, including women, aboriginal people, visible minorities, and people with disabilities. Interested individuals are asked to mail applications to: Murray Davis, Ph.D., CA., Chairman, Accounting Faculty of Management, The University of Calgary, 2500 University Drive, N.W., Calgary, Alberta T2N 1N4.

#128 WESTERN NEW ENGLAND COLLEGE, Department of Accounting has a tenured-track faculty position available beginning Fall 1990 for accounting courses in the School of Business. A doctorate in Accounting is required. A strong student orientation and commitment to teaching are required. Salary is competitive. Send letter of application, vita, names of six references with addresses and telephone numbers, and an official transcript of your highest degree work to: Dr. Stanley Kowalski, Jr., Dean, School of Business, Western New England College, 1215 Wilbraham Road, Springfield, MA 01119. Deadline for applications is extended to February 15, 1990. Western New England College is an equal opportunity employer.

#129 THE UNIVERSITY OF MONTANA. The Department of Accounting and Finance invites applications for positions at the assistant or associate level in financial accounting and auditing beginning in September 1990. Candidates should possess the doctorate or be near completion. The School of Business Administration is accredited by AACSB at both undergraduate and graduate levels. Send letter of application and current vita to: Dr. Bruce P. Budge, Chairman, Department of Accounting and Finance, University of Montana, Missoula, Montana 59812. Position will remain open until filled. The University of Montana is an EO/AA employer.

#130 LA SALLE UNIVERSITY seeks applications for two tenure-track positions at Assistant/Associate level. Ph.D. in accounting. ABD near completion also considered. Nine-hour teaching load (two preparations) in MBA and undergraduate programs. We seek persons with balanced commitment to excellence in teaching and research. Strong institutional support for both including office and classroom micros, COMPUSTAT/CRSP. Informal participatory environment where your involvement is sought. Accounting Department has 500 majors and 13 full-time faculty. La Salle is a 125-year-old private institution with 6,500 students. Send resumé to: Joseph Markmann, Chairman, Accounting Department, La Salle University, Philadelphia, PA 19141. EEO/AA Employer.

#131 NORWICH UNIVERSITY seeks applicants to fill a vacancy on the accounting faculty for Fall 1990. The University offers a major and a minor in accounting. Primarily a teaching institution, faculty work closely with students and are encouraged to perform research and engage in consulting activities. Candidates with the PhD or DBA are preferred; however, candidates with the MBA/CPA will be considered. A strong background at the master's level in economics would be helpful but not required. Send *curriculum vita* and names of three references by February 9, 1990 to: Chair, Accounting Search Committee, Division of Business and Management, Norwich University, Northfield, VT 05663. EOE.

#132 BENTLEY COLLEGE is seeking candidates for faculty positions leading to tenure in the Department of Accountancy. Appointment rank and salary are highly competitive, dependent on the applicant's background, experience, and publication record. Candidates should have a doctorate or be near completion of the dissertation, have strong teaching ability, and have an interest in doing research. Bentley College is an independent, AACSB-accredited, coeducational institution with a reputation for quality education in accountancy. The Department of Accountancy offers programs at both the undergraduate and graduate levels and has over 1,300 majors with a full-time faculty of 26 individuals. Bentley College is an equal opportunity, affirmative action employer. Please contact: Dr. Clifford D. Brown, Chairperson, Department of Accountancy, Bentley College, Waltham, MA 02154-4705. (617) 891-2210.

#133 CLARK UNIVERSITY, Assistant Professor of Accounting. Candidates should hold the Ph.D. in accounting or business administration with either the C.P.A. or C.M.A. and must have a strong interest in doing original research. Clark is a small selective university which fosters an unusual combination of academic rigor and close working relationships with students. The MBA and baccalaureate degrees are accredited by the AACSB; the MHA is accredited by the ACEHSA. Clark's location in central Massachusetts (40 miles from Boston) offers an exceptionally rich cultural life and the natural beauty of New England. The position will be available on September 1, 1990. Applications will be accepted until the position is filled. Send application, curriculum vitae, and names of at least three references to: Robert Ullrich, Dean, Graduate School of Management, Clark University, 950 Main Street, Worcester, MA 01610-1477.

#134 COLLEGE OF BUSINESS AND MANAGEMENT-NORTHEASTERN ILLINOIS UNIVERSITY. Applications are invited for Ph.D./D.B.A. in Accounting for the areas of management information systems, auditing, and federal income taxes. Tenure-track positions at the assistant/associate rank. Teaching experience preferred. Must have commitment to research. Positions begin August 1990 and selection process begins immediately and continues until filled. Send resumé, transcripts, and names of three references to: Olga E. Engelhardt, Dean, College of Business and Management, Northeastern Illinois University, 5500 N. St. Louis, Chicago, Illinois 60625. AA/EOE.

#135 SALISBURY STATE UNIVERSITY invites applications for a tenure-track position in Accounting beginning in the Fall of 1990. Qualifications include a doctoral degree and commitment to excellence in research and teaching. Teaching responsibilities include undergraduate, MBA, and Executive MBA accounting courses. Salary and rank commensurate with qualifications and experience and are AACSB competitive. Salisbury State is a university of 5,500 students divided among five schools and located 30 minutes, by car, from the Chesapeake Bay or the Atlantic Ocean, and 20 minutes, by air, from Baltimore, Washington, or Philadelphia. Please send letter of interest and vita to: Professor Doug Marshall, Director of Accounting Program, Salisbury State University, Salisbury, Maryland 21801.

#136 THE UNIVERSITY OF ALABAMA IN HUNTSVILLE, CHAIRPERSON-ACCOUNTING. Candidates must have an earned doctorate in accounting, professional certification, and qualify for appointment as full or associate professor. Candidates are expected to have an established record as an effective teacher, publications in refereed journals, leadership skills, and interpersonal skills. Administrative experience preferred. Position available September 1990. Compensation is AACSB competitive. Applications should include a current vita and the names of three references. Send applications, nominations, and requests for additional information to: Dr. Grover L. Porter, Chairman, Accounting Search Committee, Department of Accounting and Business Legal Studies, College of Administrative Science, The University of Alabama in Huntsville, Huntsville, AL 35899. Position will remain open until acceptable candidate is found. The Committee will begin reviewing applications January 15, 1990. The University of Alabama in Huntsville is an equal opportunity institution and does not discriminate with respect to race, color, creed, sex, age, national origin, handicap, or veteran status.

#137 SOUTHERN CONNECTICUT STATE UNIVERSITY invites applications for a tenure-track position in Accounting, starting Fall 1990. A Ph.D. or a DBA completed or near completion is preferred. Minimum qualifications are a CPA or CMA and a MBA or MS in business. Professional public accounting with a national firm or strong industry experience highly desirable. Salary and rank are competitive and dependent upon qualifications and prior experience. Submit resumé by February 1, 1990 to: Chairperson of the Search Committee, Department of Accounting, Southern Connecticut State University, 501 Crescent Street, New Haven, CT 06515. Southern is an Affirmative Action/Equal Opportunity Employer.

#138 THE DEPARTMENT OF ACCOUNTING AT MICHIGAN STATE UNIVERSITY invites applications for a tenure-track position, beginning September 1, 1990 or shortly thereafter. Applicants' primary research interests should be in financial accounting or in behavioral/organizational/control areas. Teaching interests should be in financial or managerial accounting at all (doctoral, masters, undergraduate) levels. Rank: Assistant Professor, Appointment as Associate Professor is authorized if qualifications warrant. Qualifications: Doctoral requirements completed or in final stage in an appropriate research-oriented program. Applicants should present a record or demonstrable prospects of quality scholarly research and excellence in teaching. References will be strongly considered in our offer decisions. Michigan State University is an affirmative action employer and applications from women or minority candidates are particularly invited. Send letter of application, resumé, and letter(s) of reference to: Dr. George C. Mead, Department of Accounting, Graduate School of Business Administration, Michigan State University, East Lansing, MI 48824.

#139 PURDUE UNIVERSITY. Applications are invited for a position in accounting beginning in August 1990. Rank is open depending upon qualifications. A Ph.D. or D.B.A. degree is required. Candidates for appointment must exhibit capacity for quality research and teaching. Resumés should be sent, before March 15, 1990, to: Professor Robert Eskew, School of Management, Purdue University, West Lafayette, Indiana 47907. Telephone (317) 494-4469. Purdue University is an Affirmative Action/Equal Opportunity Employer.

#140 ANTICIPATED OPENING FOR TENURE-TRACK PROFESSORIAL POSITION, rank open, in managerial accounting, financial accounting, or auditing, to start September 1990. Doctorate required, with record of excellence in research and teaching; advanced ABD's will be considered at the instructor level. Competitive compensation; excellent fringes. Applications received by February 20 will receive highest priority. Send vita, three letters of reference, and transcripts to: Dr. Arthur Adelberg, Chairman, Department of Accounting and Information Systems, PH 109, Queens College of the City University of New York, 65-30 Kissena Blvd., Flushing, New York 11367. AA/EOE.

#141 CALIFORNIA STATE UNIVERSITY, SAN BERNARDINO (CSUSB) has openings in Taxation and Accounting Information Systems. Candidates will be considered at all ranks. Quality teaching is emphasized; research and service activities are also expected. Candidates should have a doctorate or, for tax, the LLM/CPA combination. The selection process will begin immediately and continue until the positions are filled. Send resumés to: Dr. Eldon C. Lewis, Chair, Department of Accounting and Finance, California State University, San Bernardino, 5500 University Parkway, San Bernardino, CA 92407. CSUSB is an Equal Opportunity Affirmative Action, Section 504, Title IX Employer.

#142 UNIVERSITY OF MINNESOTA'S ACCOUNTING DEPARTMENT invites applications for Assistant Professor of Accounting. Associate or Full Professor rank considered subject to applicant's qualifications and department needs. Visiting position will be considered. Applicants should possess a Ph.D. or expect Ph.D. by September 16, 1990. Responsibilities include conducting research, service, and teaching. Two application pools will be formed. Applications must be received prior to March 1, 1990 for tenured/tenure-track positions and prior to May 1, 1990 for visiting positions. University of Minnesota is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities. Please send application and vita to: David Dittman, Accounting, Carlson School of Management, University of Minnesota, 271 - 19th Avenue South, Minneapolis, MN 55455-0413. Telephone (612) 624-6506.

#143 THE COLLEGE OF BUSINESS ADMINISTRATION OF NORTHEASTERN UNIVERSITY is seeking applications for the Joseph M. Golemme Research Professorship. The Golemme Professorship was established in honor of Professor Joseph M. Golemme, the founder of Northeastern's nationally recognized Graduate School of Professional Accounting. The Professorship will be a three- to five-year renewable faculty appointment. The applicant is expected to be actively involved in research and publication and to provide research leadership. Teaching will be at a reduced level. Northeastern University is one of the nation's largest private universities and is a world leader in cooperative education programs. All programs are fully accredited by the American Assembly of Collegiate Schools of Business. Please send nominations and applications with a current resumé to: Sharon McKinnon, Accounting Group Coordinator, College of Business Administration, Northeastern University, 404 Hayden Hall, Boston, Massachusetts 02115. Northeastern is an Equal Opportunity/Affirmative Action, Title IX University.

#144 UNIVERSITY OF ILLINOIS, Department of Accountancy, invites applications at all ranks in accounting. Candidates are expected to possess a doctoral degree or be near completion of degree and should be dedicated to excellence in teaching and research. We also invite applications for the Irwin Jecha Distinguished Professorship in Accountancy. Although individuals with scholarly records in any area of accounting will be considered for the position, we would prefer to find one who is able to play a leadership role in the empirical research domain. The University of Illinois is an equal opportunity, affirmative action employer. Please send vita to: Professor Lawrence A. Tomassini, Recruiting Committee Chair, Department of Accountancy, University of Illinois, 360 Commerce West, 1206 S. Sixth Street, Champaign, IL 61820. Telephone (217) 333-2451.

#145 CHAIRPERSON, ACCOUNTANCY DEPARTMENT, WESTERN MICHIGAN UNIVERSITY. Candidates should have a doctorate in accounting and an established record in research, teaching, and professional service. Administrative experience and certification is desirable. Rank and salary are commensurate with experience. The department has a strong undergraduate program and offers an M.S. in Accountancy. The Haworth College of Business is accredited by the AACSB at the undergraduate and graduate levels. WMU has over 26,000 students, with 5,600 undergraduates and 900 graduates in the College. WMU is classified as a Carnegie Doctoral Level I University and consists of six colleges. It is a state-assisted institution controlled by an autonomous Board. The position is available August 15, 1990. Applications with a resumé and references should be sent to: Dr. Carol Stamm, Haworth College of Business, Western Michigan University, Kalamazoo, MI 49008, by February 15, 1990. (616) 387-7065. WMU, an Equal Opportunity Employer, solicits qualified women and minority applicants.

#146 THE UNIVERSITY OF NORTHERN IOWA invites applicants for tenure-track positions in Accounting at the Assistant, Associate, or Professor rank beginning Fall 1990. While all areas will be considered, the primary needs are Accounting Systems and/or Managerial. An earned doctorate (ABD considered) and potential for scholarly research and teaching excellence are expected; professional certification is desirable. The CBA has 77 faculty members, approximately 1,250 undergraduate majors, and 140 MBA students. Construction of a new $10 million CBA building is underway with completion scheduled for Fall 1990. Cedar Falls, a pleasant residential community (35,000) and adjacent Waterloo (75,000) form an area with outstanding educational, cultural, medical, and recreational options in Northeast Iowa. Applications accepted until positions are filled. Contact Professor Gerald Smith, Head, Department of Accounting, College of Business Administration, University of Northern Iowa, Cedar Falls, IA 50614-0127. (319) 273-2394. UNI is an affirmative action/equal opportunity educator and employer.

#147 POSITION WANTED—MBA, CPA, CMA, PhD seeks Fall 1990 tenure-track position in a strong institution which emphasizes and rewards good teaching. My experience includes teaching and academic administration. My teaching experience includes most managerial and financial areas, including advanced and governmental. I could teach other topics. If you require a doctorate in accounting, I would be happy to commit myself to systematic progress toward that goal if you have an appropriate program in your vicinity.

#148 GEORGIA SOUTHERN COLLEGE is seeking applicants for a tenure-track position at the rank of Assistant Professor of Accounting starting Fall 1990. Ph.D. or ABD is required; CPA or CMA highly desirable. The School of Business offers AACSB-accredited undergraduate business and MBA programs. With over 11,000 students, Georgia Southern is the largest and one of the fastest growing senior colleges in the University System of Georgia. The Board of Regents has granted University status to the institution effective July 1990. Application deadline: February 15, 1990. Send letter of application and resumé to: Dr. William J. Bostwick, Department of Accounting, L.B. 8141, Georgia Southern College, Statesboro, GA 30460. Georgia Southern College is an affirmative action/equal opportunity employer which encourages women and minority candidates to apply.

#149 THE UNIVERSITY OF TENNESSEE AT CHATTANOOGA invites applications for two tenure-track positions beginning August 1990. Rank is open, based on qualifications and experience. Candidates should have a Ph.D. or DBA in Accounting with an interest in the tax, systems, or managerial area. ABD will be considered. The University places a balanced emphasis on teaching and research. The University has an enrollment of 8,000 students. The School of Business Administration has 1,600 undergraduate students and 250 MBA students. Applications should be sent to: Dr. John Fulmer, Head, Department of Accounting and Finance, University of Tennessee at Chattanooga, Chattanooga, Tennessee 37403. Women and minorities are encouraged to apply for all positions. The University of Tennessee at Chattanooga is an equal employment opportunity/ affirmative action/Title IX/Section 504 institution.

#150 ACCOUNTING FACULTY POSITION, YORK COLLEGE OF PENNSYLVANIA (January or September 1990). Individual to teach general accounting courses with emphasis on auditing and taxation. Doctorate degree preferred, CPA plus MBA or MS in Accounting given serious consideration. Some teaching experience desirable. Rank and salary dependent on qualifications. YCP is a private, independent, predominantly four-year institution located in south-central Pennsylvania, with an enrollment of about 3,200 FTE students. Send resumé and transcripts to: Dr. Glenn F. Briercheck, Chairman, Department of Business Administration, York College of Pennsylvania, York, PA 17403-3426.

#151 ST. JOHN FISHER COLLEGE invites applications for a tenure-track accounting faculty position starting August 1990. An earned doctorate is required; professional certification and relevant work experience preferred. Rank and salary commensurate with experience. The department is in the process of developing a 150-hour program in accordance with the AICPA requirements. St. John Fisher College is an independent, liberal arts college located in the beautiful Finger Lakes region of New York. Its accounting department is highly regarded in the community. Send resumé and the names of three references to: Barbara Fuge, Chair, Accounting Department, St. Fisher College, 3690 East Avenue, Rochester, NY 14618. AA/EEO employer.

#152 FRANKLIN AND MARSHALL COLLEGE, Department of Business Administration is seeking a teaching and research oriented person to fill a tenure-track position with primary emphasis on managerial accounting. F & M is a highly selective liberal arts college with a well-known, effective accounting program. We expect the applicant to hold the Ph.D. or be very near completion. Contact: Dr. Alan Glazer, Chairman Accounting Search Committee, Department of Business Administration, Franklin and Marshall College, P.O. Box 3003, Lancaster, PA 17604. The College and this department are committed to cultural pluralism through the hiring of minorities and women.

#153 THE UNIVERSITY OF SOUTH CAROLINA AT AIKEN, School of Business invites applications for three tenure-track positions in accounting commencing Fall 1990. Positions available in auditing, tax, and information systems. Prefer Ph.D.'s with major in accounting and minor in finance, tax, or information systems. Certification and auditing experience desirable. ABDs in advanced stage of dissertation will be considered. Commitment to undergraduate teaching and research potential required. Salary and rank competitive. Application deadline is February 1, 1990. USC–Aiken is a senior institution of the University of South Carolina System. The School of Business at USCA offers the Bachelor of Science Degree in Business Administration with concentrations in accounting, finance, marketing, and management. Please send vita, graduate transcripts, and three letters of recommendation to: Professor Raj Singhal, Chairman, Accounting Search, School of Business, USC at Aiken, 171 University Parkway, Aiken, SC 29801. An Affirmative Action/ Equal Opportunity Employer.

#154 THE UNIVERSITY OF SOUTHERN MAINE Department of Accounting invites applicants for tenure-track appointments at the Assistant or Associate Professor level to begin September 1, 1990. Our teaching needs include auditing, financial accounting, and managerial/cost accounting. Candidates should possess a doctorate in accounting, but ABD will be considered. Teaching effectiveness is emphasized along with expectations of scholarly research and public service. Salary and benefits are competitive. The University is a growing, dynamic institution with 10,000 students located in Portland, Maine's largest city, less than two hours north of Boston. The University of Southern Maine hires only United States citizens and lawfully authorized alien workers. Review of applications will begin February 1, 1990. Please send your resumé to: Dr. Sue H. West, School of Business, Economics and Management, University of Southern Maine, 96 Falmouth Street, Portland, Maine 04103. An Equal Opportunity/Affirmative Action Employer. RE:101.

#155 ACCOUNTING FACULTY EASTERN MICHIGAN UNIVERSITY. Eastern Michigan University's College of Business is located in a dynamic business environment, between Detroit and high-tech Ann Arbor areas. We are seeking motivated faculty holding doctoral degrees in accounting (preferably Information Systems and Auditing) to fill tenure-track positions. Responsibilities include: teaching at the undergraduate and master's levels, advising students, doing research and writing, and taking part in professional development opportunities. Rank is dependent upon qualifications. ABD will be considered. Salary and benefits are very competitive. For consideration, send detailed resumé to: Position ACCTG. Faculty, 310 King Hall—Human Resources, EASTERN MICHIGAN UNIVERSITY, Ypsilanti, MI 48197. Inquiries to: (313) 487-3320. We take pride in the pursuit of our affirmative action objectives and encourage qualified women and minorities to consider this opportunity. Multicultural experience desired.

#156 AMERICAN UNIVERSITY, Washington, D.C. Applications are invited for two tenure-track accounting faculty positions. One position is designated for a TAXATION specialist qualified to teach in our highly regarded M.S. in Taxation program. The second position is intended for a FINANCIAL, MANAGERIAL, OR AUDITING specialist. Applicants must be effective teachers with a serious commitment to scholarship and professional service. An appropriate doctorate (or LLM in taxation) is required. Professional certification (CPA) is highly desirable for both positions. All ranks will be considered. Appointments at senior ranks normally require four years of service at TAU before tenure consideration. Research and professional opportunities in the nation's capital are excellent. Applications should be sent to: Dr. Philip F. Jacoby, Chair, Accounting Department, Kogod College of Business Administration, The American University, Washington, D.C. 20016. The American University is an equal opportunity, affirmative action employer. Applications from women and minorities are especially invited.

#157 The UNIVERSITY OF EVANSVILLE invites applications for the position of Assistant Professor of Accounting in the areas of cost accounting and accounting theory. Some teaching in intermediate accounting or principles of accounting is also likely. Courses are primarily at the undergraduate level. The University of Evansville is a small, private institution. Excellence in classroom teaching is expected along with a modest, complementary research focus. Applicants should have the Ph.D. or D.B.A. degree, or be in the dissertation stage of their program. The position is available August 1990. Please send a resumé to: Dr. Dale Hockstra, Dean, School of Business Administration, The University of Evansville, 1800 Lincoln Avenue, Evansville, IN 47722 or call 812-479-2851. An equal opportunity and affirmative action employer.

#158 UNIVERSITY OF ALASKA has an Assistant or Associate tenure-track faculty opening in its AACSB-accredited undergraduate accounting program effective August 1990. Candidates must hold a doctorate and should be dedicated to teaching excellence and scholarly research. Financial accounting is the preferred field but others will be considered. Experience and/or certification is desirable. Salary is competitive and commensurate with qualifications and experience, fringe benefits are outstanding. A ten-month contract is possible. Apply to: Dr. Clifford Cox, Dept. of Accounting, School of Management, University of Alaska, Fairbanks, Alaska 99775-1070. UAF is an Equal Opportunity/Affirmative Action Employer.

#159 UNIVERSITY OF TEXAS–PAN AMERICAN seeks to fill two positions at any level, one possibly a chair. For September 1990. In all areas, teaching currently mainly at undergraduate level. Ph.D. is required for tenure-track. ABDs offered one-year appointments. Salary competitive with AACSB schools. No state income tax. Below average housing costs: four bedroom house with pool $90,000; townhouse $340 per month. Pan American merged September 1989 with University of Texas System. Enrollment growing by four percent per year, and currently is 12,500. Undergraduate business and MBA programs are AACSB-accredited. Pan American is located in South Texas, 60 miles from the Gulf of Mexico and 15 miles from Mexico. The U.S. population within a 15-mile radius is 225,000. Mild winters, seldom freezing weather. Send resumé to: Dr. Charles J. Ellard, Chair, Department of Accounting and Economics, School of Business, University of Texas–Pan American, Edinburg, TX 78539. Telephone (512) 381-3354.

#160 ACCOUNTING—West Chester University's Department of Accounting seeks applicants for a full-time, tenure-track position for September 1990. Duties include teaching undergraduate and graduate levels, student advising, program development, and professional development. Ph.D./DBA preferred, but ABD will be considered; (Master's Degree with CPA/CMA may be considered); professional experience in accounting required. Rank and salary commensurate with qualifications. Send vita postmarked by February 15, 1990 to: Dr. S. Theodore Hong, Accounting Dept., WEST CHESTER UNIVERSITY, West Chester, PA 19383. AA/EOE. Women and minorities are encouraged to apply.

#161 THE UNIVERSITY OF TEXAS AT EL PASO is seeking applications to fill a tenure-track position at the assistant/associate professor level for its AACSB Accounting Accredited program. The position is in the area of taxation. Candidates for assistant professor should possess a L. LM. or Ph.D. and preferably hold the CPA certificate. Candidates for associate professor should also have a record of research and publication and provide evidence of teaching excellence. Professional experience is also desirable. The position is subject to budgetary approval. The Department of Accounting offers undergraduate and masters programs. The masters program also offers a tax concentration. El Paso, Texas offers a moderate climate with four seasons, outstanding recreational activities, and reasonable airfare to every city in the Southwest and Western portions of the United States. Send vita to: Richard G. Schroeder, Department of Accounting, College of Business Administration, University of Texas at El Paso, El Paso, Texas 79968-0542. The review of applications will commence February 1, 1990. Applications will be reviewed until the position is filled. The University of Texas at El Paso is an Equal Employment Institution and an Affirmative Action Employer.

#162 WAKE FOREST MBA. The Babcock Graduate School of Management has an opening for an assistant or associate professor to teach at the graduate level and conduct research in financial and managerial accounting. A doctorate is required. An MBA degree is desirable. Prior teaching or business experience is preferred. Candidates should have the interest and demonstrated potential to develop a strong research program to complement a profile of teaching excellence at the MBA level. Position available for Fall 1990. Wake Forest University is an affirmative action, equal opportunity employer and actively solicits applications from qualified women and minority candidates. Send vita to: Faculty Recruiting Committee, Babcock Graduate School of Management, Wake Forest University, Box 7659 Reynolda Station, Winston-Salem, NC 27109.

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Measuring Production Efficiency in a Not-For-Profit Setting

Robert D. Hayes
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SYNOPSIS: Productivity measurement has not generally been considered part of the information that managers use in planning and control decisions. Kaplan (1983) criticizes accounting research for the lack of studies on production efficiency stating that the effects of output volume and substitution possibilities among key production inputs on productivity measures have not been the subject of any accounting research. Hasseldine (1967), Mensah (1982), and Marcinko and Petri (1984) have addressed the shortcomings of traditional financial measures of productive efficiency. Barlev and Callen (1986) show that input standards should not be defined independent of input prices, the state of technology, and the level of output. These authors, however, provide no empirical applications. This study provides empirical evidence related to performance measures of efficiency of production.

Traditional budgeting methods and measures used for analysis may provide inadequate information for effective performance evaluation and control monitoring. This is particularly true if the budget model assumes that input cost shares are fixed. Analytical methods including budget analysis that fail to consider available input substitution possibilities in response to changes in relative input prices, and methods that fail to consider changes in operating conditions, may result in lost opportunities for cost savings. For example, traditional methods of assigning responsibility for accounting variances tend to focus attention on meeting the budget and may divert attention from production input-mix decisions when relative input prices change.

For this study, we obtained data on the output produced and the input consumed via on-site visits to 33 county correctional institutions (jails) in Tennessee. A multivariate regression system of simultaneous equations

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and a translog cost function specification were employed to analyze these data. Our empirical model specification required input prices, output levels, and the state of technology as independent variables (not summary financial measures) to explain total operating expenditures for the budget period. Agency theory provides a means for inferring managerial behavior. The translog cost function coefficients provide essential information about variability in input cost shares for the sample data.

Based on the hypotheses tested, we rejected the reasonableness of the conventional budget model assumption of fixed cost shares. We provide empirical evidence that managerial decisions based on matching expenditures and appropriations in line item budgets may not be cost-minimizing. The evidence suggests that a translog budget model may produce additional useful performance evaluation and control monitoring information that is not available from budget models which assume that cost-minimizing input cost (budget) shares are fixed.

Key Words: *Agency, Budget, Nonprofit, Production.*

Data Availability: *Data used in this study may be obtained from the authors on request.*

IT has been inferred that public administrators are rewarded for matching appropriations and expenditures (Jones and Thompson 1986). This reward system may be appropriate if the organizational objective is to provide a predetermined level of output within an upper spending limit. In this environment, management may pursue a goal of zero budget variance (i.e., expenditures = appropriations) in order to have its performance viewed positively. There is at least anecdotal support for the practice in public management of spending any surplus appropriations. Furthermore, the fear of having future appropriations reduced provides an additional incentive to spend all appropriations. For example, future performance evaluations may be influenced by reductions in appropriations that increase the risk of not achieving output goals (assuming that it would be more difficult for administrators to provide the current level of services at lower funding levels). This risk often is manifested in unfavorable public reaction to reduced services.

Agency theory reasons that managerial decision making is strongly influenced by the applicable performance evaluation system. (See Baiman (1982) for a synthesis of agency literature as it relates to management accounting.) As a result of the reward system inherent in an evaluation system, agency theory posits that the agent may take actions that, while in the agent's best interest, are not cost-efficient for the organization. In practice, therefore, an incentive to emphasize a year-end zero balance may result in suboptimal organizational performance where administrators are evaluated on the basis of matching appropriations and expenditures. An interesting question is whether managers in actual budgetary settings sacrifice opportunities to select more economical sets of inputs (efficiency) in order to attain goals, implicit or explicit, in their performance evaluation schemes. We examine some issues related to this question.

According to the Committee on Accounting for Not-for-profit Organizations (1971, 125), "managers of profit-seeking as well as non-profit organizations have a primary responsibility of optimizing the utilization of available resources." In order to optimize the utilization of resources, management must have a viable information system including relevant budget information (Freeman et al. 1988). Many budget procedures have been suggested; however, the predominant practice in nonprofit organizations is the line-item approach (Lynn and Freeman 1983). From an agency perspective, when performance is measured via line-item budget variances, management has incentives to make decisions that equate expenditures and appropriations. In practice it is not unusual for budgets to be amended *ex post* so that actual expenditures do not exceed revised appropriations. This is usual where state laws are very strict in prohibiting expenditures in excess of appropriations. This practice is strong evidence that line-item budgets are not effective control/evaluation devices.

Measuring efficiency of public administrators requires that actual results be compared to ideal cost standards. These ideal cost standards are defined by the underlying production function. To be ideal standards, budgets must incorporate the technological relationships of the production function. Budgeted line-item amounts represent fixed percentages or shares of the total budget for all input price relationships. The total budget amount is fixed and the line-item amounts are fixed ($C=\Sigma C_i$ and $C_i=p_i q_i$; where C is total appropriation, C_i is appropriation for line-item i, and $p_i q_i$ are the price and quantity of input i). It follows that line-item budgets, as ideal standards, require that the underlying production function be characterized by fixed input cost shares (a cost share is defined as cost of an input ÷ cost of all inputs).

Duality theory (Barlev and Callen 1986) is an accepted vehicle for inferring production function relationships (i.e., ideal standards) using a cost function approach. We employ duality theory via a system of input cost share equations to gain insight into responses of local government managers to changes in relative prices of production inputs. Specifically, the primary issue addressed is whether cost shares are fixed for all input price relationships.

Our study uses data from management practice in an actual nonprofit budgetary setting to test whether input cost shares are independent of input prices while controlling for operating characteristics. The procedure used includes identification of the underlying cost structure in the sample data and determination of whether this cost structure supports or fails to support the notion of fixed cost shares.

The remainder of this article consists of (1) the background on substitution among production inputs, (2) the model for testing the fixed cost share hypothesis, (3) the data, (4) the empirical results, (5) implications of results, and (6) summary.

I. Background

Where the objective is to minimize the cost of a given level of output, budgeted inputs reflect the best estimate of input prices, quantities, and combinations of quantities that will go into production. If significant input substitution possibilities exist, different combinations of inputs may be capable of generating a given level of output. Thus, a cost-minimizing budget reflects the technological (i.e., input/output) relationships that define the production function. The production function, however, does not express input/output relationships in cost-minimizing terms. The cost-minimizing input combination for a given level of output, of course, depends on the relative prices of inputs. Accordingly, as an ideal standard for performance evaluation, the budget embodies management's perception of the underlying production function and input prices.

In practice, budget variance analysis is a tool often used to measure production efficiency and effectiveness. While the goal of top management may be to minimize the cost of output, operating decisions made at lower levels ultimately affect the cost of output. For example, if the budgeted input quantity is achieved, attention may be diverted from production personnel when budget-variance analysis assumes input quantity ratios are unresponsive to changes in relative input prices (Mensah 1982, 689). There is little incentive to make input quantity adjustments reflect either relative input price changes or changes in the operating characteristics of the production environment if production personnel are expected to maintain budgeted input quantity ratios. Therefore, when actual operating results are compared with planned results, but not with ideal results, opportunities for cost savings may go undetected.

Production function relationships as ideal standards should be incorporated in the organization's budget model in order to avoid potentially misleading signals associated with traditional standard-cost variance analysis and to provide a more relevant budgeting/variance reporting system (Demski 1967; Hasseldine 1967; Jaedicke 1962; Mensah 1982; Marcinko and Petri 1984). Barlev and Callen (1986) provide an interesting literature survey on the subject of productivity measurement and show that input standards cannot be defined independently of input prices, the state of technology, and the actual level of output. While the literature has addressed the apparent shortcomings of conventional budget models, no empirical test of suggested shortcomings has been presented for either profit or nonprofit organizations. We present evidence for a specific sample of local governmental budgeting units.

II. The Model for Testing the Fixed Cost Share Hypothesis

It has been shown that a unique correspondence between a cost function and the associated production function exists when certain regularity conditions are met (Shephard 1970). Diewert (1974) demonstrated that the translog cost function specification is particularly useful for representing relationships of the associated production function and that it is capable of meeting the general regularity conditions of homogeneity of degree one in input prices, concavity, and positivity, required of duality theory. Caves et al. (1981, 996) have shown that the translog variable cost function provides all the information required to infer production function relationships. Therefore, the translog variable cost functional form is used to implement duality theory in this study. (See Abdel-khalik (1988) for an example of an empirical study that utilizes a Cobb-Douglas production function assumption and does not rely on the linkage between production and cost functions implied by duality theory.)

A variable-input cost equation (hereafter referred to as cost equation) and two $(n-1)$ cost share equations were fitted as a multivariate regression system of simultaneous equations. The general form of the cost function is $VITC=g(p,t)$. The fitted translog cost equation is:

$$\begin{aligned}\ell n VITC = {} & \alpha_o + \sum_i \alpha_i \ell n(p_i) + \sum_k \beta_k \ell n(t_k) + 1/2\left[\sum_i \sum_j A_{ij} \ell n(p_i) \ell n(p_j)\right] \\ & + \sum_i \sum_k B_{ik} \ell n(p_i) \ell n(t_k) + 1/2\left[\sum_k \sum_r C_{kr} \ell n(t_k) \ell n(t_r)\right] + U_o, \qquad (1)\end{aligned}$$

where *VITC* is total cost of variable inputs; p is a vector of variable input prices; $i=1,\ldots,j$; $j=3$; t is a vector of operating characteristics variables consisting of an output variable and a capacity staffing variable; $k=1,\ldots,r$; $r=2$; U_c is the unobservable normally distributed residual term; and the subscripts i and j are as follows: 1 = price of labor input, 2 = price of boarding input, and 3 = price of maintenance-contracted services input; and the subscripts for k and r are 1 = output level, and 2 = capacity staffing level.

Inclusion of the cost share equations in the model incorporates knowledge that cost proportions must sum to unity and does not add any new unrestricted coefficients to the system of equations. Joint estimation of the cost equation and the cost share equations gives more efficient parameter estimates than ordinary-least-squares estimation of the single-cost equation (Zellner 1962; Barten 1969, 67). Cost share equation S_i is defined by taking the first derivative of the cost equation, equation (1), with respect to the natural logarithm of the price of input i (Shephard 1953):

$$S_i=\alpha_i+\sum_j A_{ij}\ell n(p_j)+\sum_k B_{ik}\ell n(t_k)+U_i, \tag{2}$$

where S_i is cost share, the proportion of total cost of variable inputs attributable to input i; U_i is the normally distributed residual term; and other terms are as before.

Because researchers may have less knowledge than decision makers about the production process, researchers may erroneously conclude, based on residuals from cost share equations, that decisions are not optimal (Stigler 1976; McElroy 1987). McElroy (1987) suggests a method to model the residuals as a systematic component of the cost shares. Parameter coefficients are robust even if residuals are not modeled as a systematic component of the cost share equations (McElroy 1987; Woodland 1979). However, the sensitivity of elasticities is inversely related to the standard errors of the cost share coefficients. Furthermore, the direction of the change in elasticity is not predictable (McElroy 1987, 753). Since in either case estimates are robust and since the results of McElroy's study are inconclusive, we do not attempt to model the unobservable knowledge attributed to the decision maker.

The Zellner (1962) seemingly unrelated regressions technique was used to provide coefficient estimates (Kmenta and Gilbert 1968). This procedure was selected because contemporaneous correlation of residuals across equations for individual observations is probable since the same independent variables appear in more than one equation. Since the cost shares must add to unity, the covariance matrix of residual terms will be singular if all cost share equations are included in the model estimation procedure. Consequently, one cost share equation was dropped from the estimation procedure. System parameter estimates are numerically invariant as to which cost share equation is omitted (Barten 1969, 67).

III. The Data Set

In an empirical analysis of production function relationships, it is important to ensure that the empirical data reflect movements along the production function rather than shifts in the production function due to productivity change. In this study, productivity growth is controlled by using cross-sectional data for the fiscal year 1 July 1983 through 30 June 1984. Expenditure data and data describing operating characteristics of (nonprofit) county correctional institutions in Tennessee constitute the budgetary setting.

A sample of 33 units remained after elimination of three units that had not maintained adequate records of important variables. Information was obtained via on-site visits at the 33 institutions. On-site visits were conducted to control for consistency and accuracy of the data. The 12 operating expenditure variables for each of the institutions were obtained from audited financial records from the Department of County Audit, State of Tennessee. Other variables for converting expenditures to prices consist of the number of inmates admitted to the facility and the physical space available at each correctional facility.

Output is measured as the number of jail-days where jail-days is the sum of daily inmate populations over the budget period. Observations on the output variable came from "jail roster sheets" maintained by the correctional institutions. A capacity staffing variable was computed as the ratio of the number of beds available to number of employees. The number of beds is fixed relative to output, while the number of staff members employed is semivariable. The percent of beds occupied is a widely accepted measure of capacity utilization; however, this variable was highly correlated with the output level variable.

The operating characteristic variable, capacity staffing, represents a measure of the state of technology. It is a proxy variable for accumulated technology differences among institutions induced by the physical nature and utilization intensity of facility resources and by the differences in qualifications of the labor force. If individual institutions employ different levels of available technology, efficiencies associated with scale economies can be confused with economies due to accumulated technology differences. Inclusion of the capacity staffing variable in the model makes it possible to isolate the effects of utilization of available technology levels on input cost shares. The capacity staffing variable explains variations in production cost not explained by output variations. The fitted model coefficient for the capacity staffing variable measures the effect on production cost of the level of capacity staffing for a given level of output. Therefore, both the capacity staffing variable and the output variable are utilized in this study.

Empirical studies often are confronted by a tradeoff between internal validity and the ability to generalize the results. Internal validity was our priority in this study. Reliable data on microlevel production process inputs and outputs are extremely difficult to obtain. The data in this study have several characteristics which facilitate statistical estimation of the model coefficients and enhance reliability of estimation results. One important characteristic of the sample data is that the services produced by these budgetary units cannot be stored. Thus, expenditure amounts do not reflect changes in assets. Other desirable characteristics of the data are that similar accounting methods were used to accumulate the data and the quality of confinement services provided by the 33 institutions was reasonably uniform as a result of an in-place state inspection and certification process.

The empirical model specification requires input prices, capacity staffing level, and output level as independent variables. Therefore, the expenditure data shown in table 1 were transformed into three variables representing unit prices of budgeted inputs for labor, inmate boarding, and maintenance-contracted services. The output variable and the capacity staffing variable are used to model operating characteristics of the produc-

Table 1
Information Used to Compute Input Prices
(Price = Expenditure Divided by Quantity)

Input	Expenditure	Quantity
Labor	Salaries, personnel benefits, payroll taxes, employee uniform rentals	Number of employees
Boarding	Food, clothing, bedding, transportation, utilities	Number of inmates admitted
Maintenance-contracted services	Repairs, maintenance supplies, contract services	Number of square-feet of administrative space

tion environment.[1] The dependent variable is total operating expenditures of the budgetary unit for the budget period.

If managerial behavior is cost-minimizing with respect to all inputs, then there exists a minimum-total-cost function dual to the efficient production function. Alternatively, if behavior is not cost-minimizing with respect to all inputs, the dual total cost function does not exist (Caves et al. 1981). Typically, quasi-fixed inputs are determined periodically during the capital budgeting phase of decision making. Subsequent choices of optimal combinations of inputs that can be varied during the utilization of the quasi-fixed inputs imply a variable cost function for which no opportunity exists for substitution between variable and quasi-fixed inputs. For the budgetary units sampled, optimal adjustment of in-place capital resources over the period of observation was unlikely. It would be unrealistic to treat such resources as variable over one budget period, and therefore the capital resources variable was not modeled as an input price variable. The estimation technique employed allows us to assume, subject to regularity conditions being met, that the data describe a production process where managerial behavior is cost-minimizing with respect to variable inputs given the level of quasi-fixed inputs.

The estimation procedure used to ensure homogeneity of degree one requires that the A_{ij} in the cost share equations be the same as those in the cost function. Since the cost share equations are the result of taking the first derivative of the cost function (eq. [1]), it would be mathematically inconsistent to eliminate this restriction. Appelbaum (1978) provides reasons, such as data limitations, that could cause the coefficients to differ statistically when the restriction is not imposed. Therefore, we did not formally test the restriction that A_{ij} be equal across equations. Consistent with prior research utilizing the translog procedure, we maintain the practice of imposing equality of A_{ij} cost share and cost function coefficients.[2]

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[1] The use of proxy variables for unobservable phenomena (output and technology) introduces measurement noise. This is an inescapable event characteristic of essentially all empirical studies utilizing less than perfect data sets.

[2] A possibility suggested by an anonymous referee is that results similar to those obtained using the translog cost function estimation procedure with the necessary restrictions might be observed if the "true" production function were Cobb-Douglas with constant cost shares and if managers maintained constant input quantity ratios.

Table 2

Translog Cost Model Coefficients and T-Ratios for Full and Reduced Translog Cost Models (Dependent variable is total operating expenditures)

Model:	*Full*		*Reduced*	
Variable	*Coefficient Value*	T-Ratio	*Coefficient Value*	T-Ratio
Intercept	13.08807	190.514	13.08269	214.389
*p*1 (labor)	0.55290	22.561	0.55314	30.051
*p*2 (boarding)	0.32062	14.344	0.31951	18.816
*p*3 (maint cs)	0.12649	9.428	0.12735	12.713
*t*1 (output)	0.79602	12.568	0.78851	14.136
*t*2 (cap-staff)	−0.54442	−5.225	−0.55335	−5.894
*p*1*p*1	0.10187	3.484	0.10560	4.088
*p*1*p*2	−0.06066	−2.641	−0.06244	−3.034
*p*1*p*3	−0.04121	−2.655	−0.04316	−3.161
*p*2*p*2	0.06286	2.779	0.06242	3.051
*p*2*p*3	−0.00220	−0.185	0.00002	0.002
*p*3*p*3	0.04341	3.806	0.04314	4.407
*p*1*t*1	−0.00136	−0.090	—	—
*p*1*t*2	−0.12390	−3.578	−0.12492	−3.987
*p*2*t*1	0.00191	0.133	—	—
*p*2*t*2	0.10076	3.012	0.10050	3.315
*p*3*t*1	−0.00055	−0.064	—	—
*p*3*t*2	0.02313	1.213	0.02442	1.434
*t*1*t*1	0.01869	0.781	0.01560	0.744
*t*1*t*2	−0.16873	−2.567	−0.17770	−3.030
*t*2*t*2	0.24102	2.343	0.25712	2.797
Weighted system *R*-square:		0.9736		0.9742
Weighted mean square error:		1.8296		1.7547
System degrees of freedom:		84		86*

* Computed as 33 observations times three equations less 18 estimated coefficients plus five restrictions equals 86 ((33 × 3) − 18 + 5).

IV. Empirical Results

Table 2 presents the coefficient estimates and *t*-ratios of the jointly estimated cost equation and cost share equations for the full and reduced models. The quadratic interaction coefficients between prices and output are not significant (this test of significance is discussed in the Implications of Results section) and, hence, the reduced model in table 2 was estimated without these coefficients. The reduced model has 86 degrees of freedom (d.f.), two more than the full model. Even though three coefficients were deleted, we gain only two degrees of freedom because of the restriction that the three coefficients sum to zero. The α_i, A_{ij}, and B_{ik} coefficients appearing in the cost equation and in the cost share equations are identical. Therefore, the cost share equation coefficients are not repeated in table 2. The *R*-squares in conjunction with a majority of statistically significant coefficients indicate acceptable goodness-of-fit.

In the fitted translog models, the required regularity conditions are satisfied. Homogeneity of degree one in input prices was incorporated in the estimation procedure as restrictions on subsets of the regression coefficients. The Hessian matrix of second partial derivatives with respect to input prices is negative semidefinite and, thus,

Table 3

Summary of F-Test Results for Input Price Interactions

Null Hypothesis	*Degrees of Freedom*	*Computed F-Ratio*	*Probability >F*
$A_{11}=A_{12}=A_{13}=A_{22}=A_{23}=A_{33}=0$ (all $A_{ij}=0$)	(3,84)	12.5676	0.0001
$A_{11}=A_{12}=A_{13}=0$ (labor share)	(2,84)	9.4001	0.0002
$A_{12}=A_{22}=A_{23}=0$ (boarding share)	(2,84)	5.9764	0.0037
$A_{13}=A_{23}=A_{33}=0$ (maintenance-contracted service share)	(2,84)	10.9299	0.0001

the condition of concavity is satisfied (Varian 1984). The condition of positivity is satisfied since the fitted cost shares are positive at each observation. Thus, the fitted translog variable cost function exhibits all the regularity conditions required for the cost-minimizing specification of duality theory.

Cost share equations in the translog model framework can be stated mathematically as:

$$S_i=\alpha_i \tag{3}$$

where the share of total cost attributable to input i, S_i, is *fixed* and is equal to the RHS intercept, α_i. Assuming S_i is fixed, input proportion i can be said to be independent of relative input prices (the A_{ij} coefficients) and operating characteristics (the B_{ik} coefficients). In order to conclude that cost shares are fixed for all input price relationships and operating characteristic relationships, the nonintercept coefficients, A_{ij} and B_{ik}, in equation (2) must be trivial. Hence, the fixed cost share hypothesis is tested by examining the significance of the fitted nonintercept cost share equation coefficients.

Estimated coefficients for interaction effects between input prices, the A_{ij} coefficients, are the basis for testing the null hypothesis that cost shares are independent of relative input prices. An F-ratio test was conducted for the composite hypothesis that all $A_{ij}=0$ simultaneously. The hypothesis that all $A_{ij}=0$ was rejected. Therefore, F-ratio tests were conducted for the composite hypotheses that individual cost shares are independent of relative input prices, i.e., each $A_{ij}=0$ across i. Computed F-ratios and associated d.f. for the tests are given in table 3.

Each of these hypotheses of fixed cost shares with respect to relative input prices is rejected at the 0.01 level. The results of the hypothesis tests indicate that cost shares are not fixed. That is, cost shares vary as relative input prices vary. Recalling that line-item budget amounts represent a fixed share of the total budget, this result suggests that line-item budgeting as a control/evaluation device is deficient. This deficiency exists because for line-item budgets to be ideal standards, the underlying production function must be characterized by fixed cost shares.

Table 4
Summary of F-Test Results for Price-Output and Price-Capacity Staffing Interactions

Null Hypothesis	*Degrees of Freedom*	*Computed F-Ratio*	*Probability >F*
$B_{11}=B_{21}=B_{31}=$ $B_{12}=B_{22}=B_{32}=0$ (all $B_{ik}=0$)	(4,84)	4.8146	0.0015
$B_{11}=B_{21}=B_{31}=0$ (k: output)	(2,84)	0.0145	0.9856
$B_{12}=B_{22}=B_{32}=0$ (k: capacity staffing)	(2,84)	9.6205	0.0002

V. Discussion and Implications of Results

The results show that cost shares varied systematically rather than randomly. Cost-minimizing behavior may be inferred based on duality relationships. For example, when managers are confronted with different relative input prices, they select input mixes that are cost-efficient for the organization. While the line-item budget does not appear to function as a control/evaluation device, the observed managerial behavior (cost-minimizing) may result from legislative monitoring in the form of the state audit or inspection and certification system.

Unfortunately, we are still haunted by the possibility that a more cost-efficient input combination might have been utilized. Optimal efficiency cannot be demonstrated with the methodology utilized in this study. We can show, however, that managers in the sample appear to be seeking to minimize costs (McElroy 1987). It can also be demonstrated that the method offers an improvement over traditional budget variance reporting systems by incorporating production function relationships (Barlev and Callen 1986). The following discussion provides an illustration of how production function relationships can enhance budgeting (control/evaluation) systems in profit and nonprofit organizations by providing insights into efficient substitution possibilities.

As discussed above, the degree of input substitution possibilities is important where relative input prices differ and the cost-minimizing input mix is contingent upon relative input prices. In addition to input mix adjustments made in response to input prices, cost-minimizing adjustments could also result from differences in operating characteristics of the production environment. The state of technology and levels of output may explain production costs through changes in relative input proportions as well as through changes in input requirements when input proportions remain fixed (Barlev and Callen 1986, 47).

An F-ratio test of the hypothesis that cost shares are independent of variations in both technology and output was conducted. The F-statistic was significant at the 0.01 level, indicating that cost shares depend on at least one of these nonprice variables. Thus, separate F-ratio tests were performed for technology and output. The F-statistics and d.f. are given in table 4. The hypothesis that cost shares are independent of capacity staffing (technology) levels is rejected at the 0.01 level. The hypothesis that cost shares are independent of output levels is not rejected. The sample data imply that cost shares vary with capacity staffing levels and are invariant to output levels. However, changes in input requirements at fixed input ratios do appear to be associated with variations in output.

If the B_{ik} coefficients are statistically insignificant, the cost share equations given by equation (2) reduce to the cost share equation given by equation (3) with respect to operating characteristic variables. Since there is objective evidence in this study that cost shares are independent of output levels, the following discussion is based on estimation results for the reduced model presented in table 2.

In the translog model framework, the cost equation, equation (1), coefficients provide a means of quantifying, or measuring, production efficiency. For example, elasticities are easily derived from translog model coefficients and provide a convenient means of interpreting the data and demonstrating the input mix choices available to management (Allen 1938; Uzawa 1962). Elasticities of substitution and direct and cross-price elasticities are traditionally defined where output and other input prices are held constant. For convenience of interpretation, the convention of holding all variables, except the variables of interest, constant at their sample means is adopted. Thus, cost elasticities, elasticities of substitution, and direct and cross-price elasticities are calculated with respect to the means of the transformed variables. Using this interpretation, the $\ell n(p_i/\overline{p_i})$ and $\ell n(t_k/\overline{t_k})$ transformations normalize each independent variable by its sample mean. Therefore, all independent variables have an expected value of one. Since $\ell n(1)=0$, holding variables constant at their means during interpretation causes them to drop out of the equation.

Inputs i and j are defined as substitutes (complements) if the proportion of input i is inversely (positively) related to the proportion of input j, where output is held constant. This relationship translates into a positive (negative) sign on the cross-price elasticity of inputs i and j in a cost-minimizing model. Cross-price elasticities for each ordered pair of inputs are presented in table 5. The three pairs of inputs appear to be substitutes as indicated by the positive signs on the cross-price elasticities. For each pair of inputs, cross-price elasticities are less than unity, or inelastic. The positive signs on the cross-price elasticities indicate the direction of the interrelations of the input quantities. The magnitudes of the cross-price elasticities indicate the relative degree to which quantities of one input are related to prices of another input.

Table 6 contains direct-price elasticities as the main diagonal elements and substitution elasticities as off-diagonal elements. Direct-price elasticities for the three inputs are negative, which confirms the expected cost-minimizing inverse relationship between prices and quantities. Elasticities of substitution for labor and boarding inputs and for labor and maintenance-contracted services inputs are less than unity. For inputs of boarding and maintenance-contracted services, the elasticity of substitution is approximately unity. Knowledge of substitution possibilities informs management of input choices. With the additional knowledge of actual input prices, management can make, and be accountable for, cost-minimizing input mix decisions. For example, as one input becomes relatively more expensive, cost-minimizing managers will shift away from it to relatively less expensive inputs.

In the translog cost model framework, the β_k coefficients in the cost equation, equation (1), are cost elasticities that measure relative efficiency at fixed input proportions. Note that no measure similar to the β_k coefficients exists in traditional budget

Table 5
Allen-Uzawa Cross-Price Elasticities (at the point of expansion)

S_j:	*Labor*	*Boarding*	*Maintenance-Contracted Services*
S_i:			
Labor	—	0.2066 (0.0372)	0.0493 (0.0247)
Boarding	0.3577 (0.0644)	—	0.1274 (0.0326)
Maintenance-contracted services	0.2139 (0.1072)	0.3196 (0.0817)	—

Notes: Allen-Uzawa cross-price elasticities are not symmetrical since they depend on input share weights; they are computed as:

$$E_{ij}=(A_{ij}+(\alpha_i \times \alpha_j))/\alpha_i.$$

Standard errors are in parentheses: $SE(E_{ij})=SE(A_{ij})/\alpha_i$.

Table 6
Elasticities of Substitution and Direct-Price Elasticities (at the point of expansion)

	Labor	*Boarding*	*Maintenance-Contracted Services*
Labor	−0.2560 (0.0467)	0.6467 (0.1164)	0.3873 (0.1938)
Boarding		−0.4851 (0.0640)	1.0004 (0.2552)
Maintenance-contracted services	(symmetric)		−0.5339 (0.0768)

Notes: Elasticities of substitution are computed as:

$$N_{ij}=(A_{ij}+(\alpha_i \times \alpha_j))/(\alpha_i \times \alpha_j).$$

Direct-price elasticities, on the diagonal, are computed as:

$$E_{ii}=(A_{ii}+(\alpha_i \times \alpha_i)-\alpha_i)/\alpha_i.$$

Standard errors are in parentheses:

$$SE(N_{ij})=SE(A_{ij})/(\alpha_i \times \alpha_j).$$

$$SE(E_{ii})=SE(A_{ii})/\alpha_i.$$

models. Cost elasticities are given directly by the linear coefficients on the capacity staffing and output variables. Table 7 contains cost elasticity and weighted cost share information for interpretation of the effects of output and capacity staffing levels on in-

Table 7
Cost Elasticities/Weighted Cost Shares
(at the point of expansion)

			Variable Inputs		
Variable	*Cost Elasticity*	/	*Labor*	*Boarding*	*Maintenance-Contracted Services*
Output Level	0.78851	:	0.78851	0.78851	0.78851
Capacity Staffing	−0.55335	:	−0.77918	−0.23881	−0.36160

where the variable input amounts are: $(\beta_k + (B_{ik}/\alpha_i))$.

put proportions and production cost. Interpretation of variations in input proportions with respect to variations in output can be quantified as follows. A 0.7885 percent increase in production cost is associated with a one percent increase in output. Input ratios are not responsive to output levels. However, input usage at fixed ratios does appear to be affected by variations in output. Hence, the 0.7885 percent increase in production cost is the sum of the 0.7885 percent increase in labor, the 0.7885 percent increase in boarding, and the 0.7885 percent increase in maintenance-contracted services.

Interpretation of variations in cost shares with respect to capacity staffing is as follows. The linear coefficient of the capacity staffing variable is negative, indicating that budgetary units can reduce total expenditures for a given output and a given facility by using fewer staff relative to the number of beds. Holding all prices and the output level fixed at their means, a 0.5534 percent decrease in production cost is associated with a one percent increase in the capacity staffing variable. The 0.5534 percent decrease in production cost is the sum of a 0.7792 percent decrease in labor, a 0.2388 percent decrease in boarding, and a 0.3616 percent decrease in maintenance-contracted services.

This analysis of operating characteristic (i.e., nonprice) variables shows that production efficiencies may not be limited to input mix adjustments that are based solely on relative input price changes. Therefore, administrators' responses also appear to be cost-efficient in regard to technology and output.

VI. Summary

Data from a nonprofit budgetary setting was used to fit a translog variable cost model. Duality theory formed the basis for interpreting the data; hence, steps were taken to ensure that the fitted translog model satisfied all the required regularity conditions for duality theory to hold. Variations in cost shares associated with variability in relative input prices and operating characteristics of the production environment were studied by examining the coefficients of translog model cost-share equations. Based on the test results, cost shares are not fixed with respect to all input price relationships or capacity staffing.

It was demonstrated that actual input/output relationships can be modeled and empirically tested. In general, examination of the *t*-ratios of the A_{ij} and B_{ik} interaction coefficients for the fitted model provided initial insight into the appropriateness of including such interaction terms in the functional specification. Thus, a functional form, such as the fixed cost share representation in equation (3), that does not allow for the interaction effects when such effects are significant, is inadequate from a statistical viewpoint and from a perspective of descriptive interpretation of the production process.

If performance evaluation and control monitoring are used to improve performance, control cost, and motivate desirable behavior, methods used for analysis should send sufficient and valid signals about the nature of the production process. Traditional analytical methods that fail to consider available input substitution possibilities in response to changes in relative input prices or methods that fail to consider changes in operating conditions provide inadequate information for performance evaluation, control, and motivation.

In the event that present performance and cost control measures send inappropriate signals, more reliable measures are clearly preferred. Evidence from this study suggests that a translog budget model may produce additional data useful for performance evaluation and control that are not available from the budget models that fail to incorporate production function relationships. In a budget share (i.e., cost share) approach, an appropriate model is a statistical cost function that uniquely represents the underlying production function and includes input prices, the state of technology, and output level as independent variables. As demonstrated, such a model is capable of providing evidence of cost-efficient behavior, and is therefore a useful performance evaluation tool.

Generalizability of the results of this research is an issue. If differences exist from state to state in the conditions under which budgetary units operate, internal validity is enhanced by selecting sample units on an in-state-only basis. On the other hand, to generalize the results beyond the state from which the sample came may not be valid. Since the sample used in the analysis was from a nonprofit service organization, to generalize to other types of production processes may not be appropriate. However, we hasten to note that we opted for internal validity in our results, thus any inability to generalize is accompanied by positive features of a more homogeneous sample.

Increased demands for accountability by resource providers (taxpayers and stockholders as well as those who would benefit from alternative uses of limited resources) have increased incentives for managers to use better tools for the measurement of production efficiency. Therefore, replications and extensions of this research may be timely for both public and private organizations. Also, further research in the area of operational auditing may lead to development of more widely accepted measures of efficiency and effectiveness.

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Auditing for Performance Evaluation

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SYNOPSIS: Williamson (1975) argues that firm organization is superior to open-market contracting due to the presence of an internal audit function that considers less formal evidence and explores byways not usually open to participants in open-market exchanges. This paper models the internal audit function as a scarce economic resource and the use of that resource for the provision of incentives. Information useful for incentives is assumed to be limited to verifiable information. The quantity of verifiable information produced by the internal audit function is constrained by either the time an internal auditor can spend verifying evidence or the time that employees have available to make such evidence verifiable (e.g., time spent with paperwork). The internal audit function is shown to produce near first-best solutions in a principal-agent model with simple and realistic policies that use only a small fraction of all available information.

The attainment of such efficiency, however, depends on the level of management to which the internal auditors report. If independence is impaired, the firm may have to resort to other sources of contracting information, such as its financial reports. Because the information contained in financial reports is more limited than that provided by the internal audit function, first-best solutions may no longer be possible. Certain inadequacies of using financial reports as incentive devices may be mitigated by allowing the employee discretion over accounting alternatives. Such acts, however, may appear to outsiders to be income manipulations aimed solely at maximizing compensation.

Key Words: *Delegated Reporting, Internal Auditing, Performance Evaluation.*

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SINCE the publication of Ronald Coase's, "The Nature of the Firm" (1937), some economists have rejected the idea that firm organization creates any distinct governance advantages, while others have contended that the firm offers control, information, or adaptive benefits not available in open-market-based transacting (see Masten 1988 for a discussion). In particular, Williamson (1975, 29–30) suggests that the internal audit function produces information not available to open-market transactors:

> The auditing advantage of internal organization in relation to interfirm organization is attributable to constitutional and incentive differences which operate in favor of the internal mode. An external auditor is typically constrained to review written records and documents and in other respects restrict the scope of his investigation to clearly pertinent matters. An internal auditor, by contrast, has greater freedom of action, both to include less formal evidence and to explore the byways into which his investigation leads.

This paper models the internal audit function as a scarce economic resource and the use of that resource for the provision of incentives. Information useful for incentives is assumed to be limited to verified information. The quantity of verified information produced by the internal audit function is constrained by either the time an internal auditor can spend verifying evidence or the time that employees have available to make such evidence verifiable (e.g., time spent with paperwork). The internal audit function is shown to produce near first-best solutions[1] in a principal-agent model with very simple contracts that use a small fraction of all available information. The attainment of such efficiency, however, depends on the level of management to which the internal auditors report. If independence is lost, the ability of the internal audit function to provide information for incentives is impaired and the firm must resort to other sources of contracting information, such as its financial reports. Because (as noted by Williamson above) the information attested to by the external auditor is more limited than that attested to by internal auditors, first-best solutions may no longer be possible. Certain inadequacies of using financial reports as incentive devices may be mitigated by allowing the employee discretion over accounting alternatives. Such acts, however, may appear to outsiders to be income manipulations aimed solely at maximizing compensation.

I. The Internal Audit Function

The scope of an internal audit department typically extends beyond financial reporting. The internal audit function also provides operational (or management) auditing. Operational auditing is not constrained by the limited informational requirements of financial reporting and considers a much wider variety of information than does a financial audit. Given that financial statements (and their supporting schedules) constitute only a small fraction of the plethora of potentially available information, the operations audit fills an important gap in the economic organization's informational requirements.

This paper considers the internal audit function's role in the provision of incentives for the firm's employees. This use imposes important requirements: the information must be difficult to dispute and manipulate, and it must be verifiable by third parties such as courts or arbitrators. These properties correspond to the hardness definition coined by Ijiri (1975, 36).

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[1] "First-best" solutions are the solutions that are implemented when no moral hazard exists.

Financial accounting information obeys the above two properties and is widely used for open-market contracting between market agents.[2] Internal auditing becomes an additional source of information useful for incentives if the information is properly documented. This paper assumes that, in some instances, the internal audit function sufficiently documents information so as to produce unmanipulated evidence for third parties who are called upon to settle contract disputes.

Note that, in practice, the output of the internal audit function is not typically restricted to incentive information. The internal audit function produces information useful for other purposes—such as helping management to make decisions. This alternative aspect of the internal audit function is not examined here.

The actual internal audit technology represented here is the fact-finding interview, a technique commonly used by internal auditors. The fact-finding interview approach puts a certain burden of proof on employees and places the internal auditor in the role of attestor rather than asserter (a role similar to that of the external auditor). The asserter (employee) must prepare information for the attestor to examine. In this context, that means that the employee must do some initial work to document his or her assertions and the internal auditor then examines this documentation to ensure that it has been properly done.[3]

Some organizations either do not have an extensive internal audit function or if they do, it may have value for performance evaluation for only a limited fraction of all agents employed by the organization. In particular, the independence that an internal auditor possesses at lower levels of the organization may be lost at higher levels. Internal auditors lose independence if not allowed to report to a level higher than that of the employee being evaluated. The American Institute of Certified Public Accountants warns external auditors to consider this fact when relying on the work of internal auditors (AICPA 1988, AU 322.07).[4] In a Conference Board survey, Bacon (1979, 36) points out that:

> [W]ithout this direct avenue of communication to the board level, the internal audit function can find it difficult to adhere to positions or recommend procedures that do not meet with management's approval, and may even have trouble getting management's cooperation in the audit process.

However, many respondents to that same survey objected to the direct reporting of the internal audit function to the audit committee because of: (1) time constraints, (2) the need of internal auditing for close supervision, (3) the benefit of internal auditing to management, and (4) the fact that unrestricted *access* not direct reporting is what is important (p. 37).[5] When the internal audit function is substantially impaired for use in performance evaluation, the organization may have to turn to its external auditor as a

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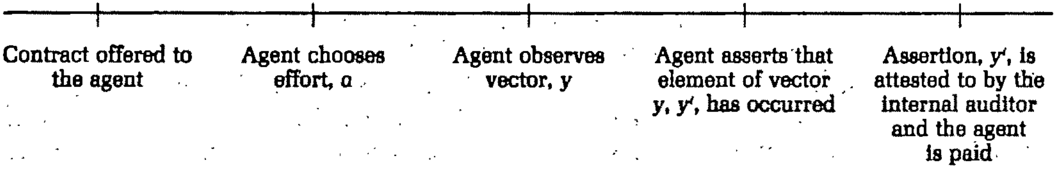
[2] Accounting information has many inadequacies. For example, see the American Accounting Association's Committee on Non-Financial Measures of Effectiveness (1971). The continued use of such flawed data is consistent, however, with the notion that the provision of incentives requires special properties not possessed by other types of information.

[3] Note that the internal audit function as represented above need not be implemented by individuals designated as "internal auditors." Similar functions are typically carried out by supervisors and staff. For convenience, however, the term "internal auditor" will be used in the paper.

[4] Abdel-khalik et al. (1983) provide an empirical study that concludes that the level to which the head of internal auditing reports is "by far" the most important factor used by external auditors in making reliance decisions on the work of internal auditors.

[5] Why the internal audit function is present (effective) or absent (not effective) for performance evaluation is a question of organizational design, an issue not explicitly addressed by this paper. In particular, this paper does not directly evaluate the four points reported by the Conference Board survey.

Figure 1
The Model


Contract offered to the agent
Agent chooses effort, a
Agent observes vector, y
Agent asserts that element of vector y, y', has occurred
Assertion, y', is attested to by the internal auditor and the agent is paid

source of incentive information upon which performance evaluation is based. However, as pointed out above by Williamson, the external auditor typically does not have access to the same variety of information encountered by the internal auditor.

Two extreme cases correspond to the above discussion: (Case A) the internal audit function is present (or effective) for the provision of incentives and (Case B) the internal audit function is absent (or ineffective) for the provision of incentives. This paper will present economic analyses to show that Case A and Case B result in the following:

> *Case A*: Performance evaluation appears to be an informal process in which an internal auditor (or supervisor or other staff member) has a meeting with a salaried employee, to which the employee comes prepared with verifiable assertions concerning his or her performance for the period. An example of such a meeting would be a cost-variance investigation where an agent is asked to supply reasons (verifiable assertions) for poor performance.
>
> *Case B*: A staff member (like the one found in Case A) may not exist and compensation must be based on externally verified performance measures such as those contained in financial reports. The employee being evaluated has the ability to influence the performance measure by utilizing discretion permitted by Generally Accepted Accounting Principles. To the outsider, such acts may appear to be income manipulations aimed solely at maximizing compensation.

In Case A, the compensation arrangement is typically a salary that does not vary much with the period's performance, yet somehow the incentive information supplied by the employee appears to be incorporated into the employee's performance evaluation as is evidenced by the expenditure of resources for documenting and verifying information. For Case B, compensation arrangements appear more formula-based and are functions of financial reports.

This paper seeks to develop a general description of internal/external auditing that can describe both of these cases. To develop this, a model is presented in section II.

II. The General Model: Case A

The model (discussed below) is summarized by the time-line shown in figure 1.

To explain the time-line, a risk-neutral principal hires a risk- and effort-averse agent with utility function $U(s)-V(a)$, where s represents compensation, $a \epsilon [0,\bar{a}]$ represents effort, $U'(s)>0$, $U''(s)<0$, $V'(a)>0$, and $V''(a)>0$. It is assumed that $U(\bullet)$ is unbounded from below.[6] Effort is assumed to be unobservable and, as such, is the source of moral hazard. The contract, $s(\bullet)$, will make use of incentive information. After the agent makes the effort choice (i.e., production decisions are made), the signal $y=(y^1,\ldots,y^N)$ is realized and privately observed by the agent. Each, element, y^i might be thought of as a separate piece of potentially verifiable evidence that helps the principal to make inferences about the agent's effort. Examples of y^i's might include information on the quality of raw materials, the labor mix, scheduling problems such as bottlenecks/rush orders resulting from other departments' behavior, working conditions, breakdowns resulting from using new and untested technologies, or disruptions due to such things as repairs or inventory-taking. The documentation of a particular y^i might correspond to a directed search providing supporting evidence that isolates the effect of a particular item (e.g., effect of labor mix, scheduling problems, etc.) on performance such as a cost-variance investigation.[7]

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[6] That is, the principal has at his or her disposal the ability to penalize the agent as much as desired. This assumption is used for the results in section III. See also footnote 13.

To be evaluated, the agent must prepare a report (a documented assertion). This assertion is then checked (attested to) by the internal auditor who reviews the documentation. The report represents the information upon which the agent's evaluation is based. To verify all evidence personally observed by the agent is typically prohibitively costly to any organization since employees have limited time allocated for documenting information and the internal audit function has limited time to review that documentation. To model this, the agent cannot disclose all of the evidence he or she possesses.[8] For simplicity, the agent is allowed to disclose (prepare and have verified) a *single* element of y, y^i (i.e., a single piece of potentially reportable information).[9] It is assumed that any disclosure indicates the value of y^i and its identity, i. That is, the internal auditor will verify not only quantitative information (the level of y^i) but also qualitative information—what part of the environment y^i is associated with (e.g., input quality, scheduling problems, etc.). Thus, the report contains not only a number but also a narrative documenting the significance of that number.

Because an internal auditor is another economic agent, capable of self-interested behavior, problems of motivation similar to those of the agent studied here may arise. The internal audit function will be designated as effective for incentive purposes (sections II and III) when the internal auditor meets with and honestly receives and verifies disclosures from the agent.[10] Such a relationship may be possible when the internal auditor is paid a wage (by a superior at a level higher than both the internal auditor and employee being evaluated) conditional on supplying properly documented reports. The success of such a policy depends on how well the documentation policy has been articulated (i.e., the ability to verify that the internal auditor has performed assigned tasks).

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[7] Typically, information like y^i is observed *in addition* to another piece of information like current production cost, call it d, and in the light of d, y^i becomes informative about effort. For example, a high value of d may be unfavorable news about effort if y^i indicates no equipment breakdowns, and favorable news about effort if y^i indicates many equipment breakdowns. To simplify the analysis, the d notation will be suppressed and each y^i by itself will be considered to be the only information from which inferences will be made. (A similar interpretation of y can be made to delete x (described below) as an argument of the contract.) Also, as shown below, it may not be necessary to incorporate d (or x) into the contract.

[8] Hart and Moore (1988) argue that it is impossible to have complete contracting (contracts covering every possible contingency) because it is impossible for economic agent to *describe* all the information that they see. This paper modifies their argument somewhat; agents are allotted a limited amount of resources to devote to developing descriptions, thus producing a limited number of them.

[9] An alternative policy would be to have the agent assert (report) the entire vector y, with the staff member randomly verifying an element y^i, imposing large penalties whenever the verified y^i is unequal to the assertion (i.e., a reporting error has been made). To report the entire y vector might require extensive preparation on the agent's part, particularly if stiff penalties are assessed for errors in the agent's report.

[10] Williamson (1975, 31) asserts "that the internal auditor can be presumed to act in the interests of the firm."

The internal audit function will be designated as ineffective for incentive purposes (in section IV) when either the function doesn't exist or, if it does exist, a lack of independence makes it of no value for compensating the agent. Collusion (lack of independence) is not explicitly modeled here (as it is, e.g., in Suh 1987); rather it is implicitly assumed that when independence is lacking, the evaluated agent can force the internal auditor to modify his or her report, resulting in a complete loss of incentive value for the information produced.

Suppose, initially, that the internal audit function is effective for incentive purposes. Let contract $s(y^i,i,N)$ represent the payoff to the agent when N signals are potentially available and it is disclosed (i.e., asserted and verified) that signal i equals y^i. Given that the agent maximizes utility, the agent will receive $s^*(y,N)$ where:

$$s^*(y,N)=\max_{y^i\in\{y^1,\ldots,y^N\}}\{s(y^i,i,N)\} \tag{1}$$

It is assumed that:

$$\sum_y U(s^*(y,N))p(y\,|\,a^*)-V(a^*)\geq H^* \tag{2}$$

and

$$\sum_y U(s^*(y,N))p(y\,|\,a^*)-V(a^*)\geq \sum_y U(s^*(y,N))p(y\,|\,\hat{a})-V(\hat{a}),\ \hat{a}\neq a^*, \tag{3}$$

where $a^*>0$ is the action desired by the principal; H^* is the opportunity expected utility of the agent; and $p(y\,|\,a)$ is the probability of y conditional on a. It is assumed that the principal and agent agree, *ex ante*, on the functional forms of the probability and utility functions. The principal chooses a^* and $s(y^i,i,N)$ to maximize:

$$\sum_x\sum_y(x-s^*(y,N))p(x,y\,|\,a^*)$$

subject to conditions (1), (2), and (3) where x is the gross benefit to the principal before compensation resulting from a^*, and $p(x,y\,|\,a)$ is the conditional joint probability of x and y. While x is potentially consumable by the principal, it is being implicitly assumed that no formal procedure exists (such as accounting) to incorporate it into the agent's contract. For example, x may be the present value of future benefits created by the agent who works in conjunction with other agents. In this case the contributions of each agent to x may be difficult to untangle and/or document.[11] Documentation procedures are assumed to exist only for elements of y.

To simplify notation, it is initially assumed that the $\tilde{y}$'s are independent and identically distributed (iid) conditional on effort: that is,

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[11] Alternatively, the analysis can be viewed as one in which the notation of x has been suppressed, as discussed in footnote 7.

$$p(y|a)=p(y^1|a)p(y^2|a)\dots p(y^N|a)$$
$$p(y^i|a)=p(y^k|a) \quad \text{if } y^i=y^k \quad \text{for any } a\epsilon[0,\bar{a}], \text{ and} \tag{4}$$
$$y^i\epsilon\{c_1,\dots,c_Q\} \quad \text{where } c_1<\dots<c_Q \quad \text{for any } i\epsilon\{1,\dots,N\},$$

where $p(y^i|a)$ is the conditional probability function for $\tilde{y}^i$, assumed to be differentiable in a. Note that "y^i" denotes the ith coordinate of vector y, and "c_j" denotes a particular value that *any* y^i is permitted to take. It is also assumed that the information can be ordered according to favorableness about the agent's performance, that is:

$$\frac{p_a(\bullet|a)}{p(\bullet|a)} \quad \text{is strictly increasing for each } a. \tag{5}$$

Condition (5) represents the Strict Monotone Likelihood Ratio Property (SMLRP) and implies that higher values of y^i are more likely given higher values of a (see Milgrom 1981). The cumulative distribution function, $F(y|a)$, is required to obey:

$$F_{aa}(\bullet|a)>0 \quad \text{for each } a. \tag{6}$$

Condition (6) is the Convex Distribution Function Condition (CDFC). CDFC says that there are diminishing stochastic returns to effort as far as generating favorable signals is concerned.

III. Internal Auditing Used for Performance Evaluation

Employees are typically allocated a limited amount of time for paperwork activities such as documenting information. Similarly, the internal audit function is allocated a limited amount of time to review the resulting documentation. To model this constraint, it is assumed that the agent is allowed to present a *single* signal to the internal auditor, and is paid on the basis of this signal. The purpose of this section is to show that a very realistic policy can emerge even when the disclosures are as limited as are those in this model.

Holmstrom (1979) and Shavell (1979) show that when *all* elements of y can be incorporated into the contract, the welfare of the principal strictly increases with N: every time another signal is added, the informativeness of the agent's performance measure increases, improving contracting efficiency. A necessary condition for this result, however, is that the set of contracts available be sufficiently rich (e.g., complex mathematical functions may be required) to optimally use the new information. However, researchers have not discovered simple and interpretable functional forms for such contracts.

This section will show that as the information available about the agents' performance becomes "sufficiently rich" (e.g., N becomes sufficiently large), there exists a very simple contract that can approximate the first-best solution, while publicly using a very small portion of all the information available. This contract corresponds to what Mirrlees (1976, 126) calls a "payment schedule approximating an instruction." Such a contract almost always pays the agent a fixed salary.

The key feature of the contract described in this section is that it allows the agent to select from all realized signals (which are *ex ante* informative about the agent's effort) a single signal (or in a more general model, a limited set of signals) that is most "favorable" about the agent's performance. Thus, a disclosure of unfavorable information implies that all signals were unfavorable, making an unfavorable disclosure very informative. In describing operational auditing, Beisser (1978, 62) illustrates a similar policy:

> Another method of handling many minor items is to point them out to the auditee during the audit and obtain his agreement to correct them. This approach is probably best as it will allow the auditee to "save face" many times and it will help the auditor obtain agreement on many items later on.

Beisser describes a policy in which not all information is communicated to superiors, particularly many items that may be embarrassing to the employee. While Beisser admittedly contemplates a more extensive operational audit than the one modeled here, his method is consistent with the policy obtained in this section.

The optimal contract when the internal audit function is effective is approximated by a simple contract with the following form:

$$s(y^i,i,N)=\begin{cases}\bar{s}(N) & \text{if } y^i\neq c_1\\ \underline{s}(N) & \text{if } y^i=c_1\end{cases} \tag{7}$$

with $\bar{s}(N)>\underline{s}(N)$.

Note that the contract is quite simple in that it is a single-step contract that imposes a penalty only when the worst is reported.[12] That is, in addition to using only a single element of the information vector, y, it uses only a part of the information contained in the element selected. Define $s^*(y,N)$ as in condition (1). The principal will choose a^*, $\bar{s}(N)$, and $\underline{s}(N)$ to maximize:

$$\sum_x x\cdot p(x|a)-\sum_y s^*(y,N)p(y|a) \tag{8}$$

subject to conditions (1), (2), and (3).

Note that contract (7) induces a "success" or "failure" partition on the set $\{y\}$. That is, when $s^*(y,N)=\underline{s}(N)$, the vector of signals, y equals $\underline{y}$; where $\underline{y}$ represents the vector for which each $y^i=c_1$. When $s^*(y,N)=\bar{s}(N)$, $y>\underline{y}$. Given $\bar{s}(N)$ and $\underline{s}(N)$, the probability of disclosing $\underline{y}$ can be defined as $P(\underline{y}|a,N)$, which equals $p(\tilde{y}^i=c_1|a)^N$. (All $p(y^i|a)$ are identical functions by assumption [4]). Furthermore, for $P_a(\underline{y}|a,N)/P(\underline{y}|a,N)$,

$$\frac{P_a(\underline{y}|a,N)}{P(\underline{y}|a,N)}=N\cdot\frac{p_a(\tilde{y}^i=c_1|a)}{p(\tilde{y}^i=c_1|a)}. \tag{9}$$

To construct the contract, an approach similar to that of Mirrlees (1974) and Holmstrom (1982) is used. Let $\bar{s}(N)$ and $\underline{s}(N)$ be defined by:

$$-[U(\bar{s}(N))-U(\underline{s}(N))]P_a(\underline{y}|a_{FB},N)-V'(a_{FB})=0, \tag{10}$$

$$U(\bar{s}(N))(1-P(\underline{y}|a_{FB},N))+U(\underline{s}(N))P(\underline{y}|a_{FB},N)-V(a_{FB})=H^*, \tag{11}$$

where a_{FB} represents the first-best action (i.e., the action that the principal would request and pay for if a were publicly observable).

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[12] That is, the agent is penalized when each $y^i=c_1$. A more intuitive way of creating the contract would be for the staff member to ask the agent if he or she has any information that sheds favorable light on that period's performance. If the response is "no," or not sufficiently favorable, the agent is assessed a severe penalty.

Condition (11) ensures that the agent will obtain at least the opportunity expected utility. Condition (10) implies that the first-order condition for the agent is fulfilled when $a=a_{FB}$. Conditions (10) and (11) imply:

$$U(\bar{s}(N))=H^*+V(a_{FB})-\frac{V'(a_{FB})P(\underline{y}|a_{FB},N)}{P_a(\underline{y}|a_{FB},N)};$$

which along with condition (9) implies:

$$U(\bar{s})=H^*+V(a_{FB})-V'(a_{FB})\cdot\frac{1}{N}\cdot\frac{p(\tilde{y}'=c_1|a_{FB})}{p_a(\tilde{y}'=c_1|a_{FB})}. \tag{12}$$

Thus, the contract pays a "wage" with probability $1-p(\tilde{y}'=c_1|a_{FB})^N$. The utility associated with that wage, $U(\bar{s}(N))$, converges to the first-best utility, $H^*+V(a_{FB})$, at a rate proportional to $1/N$. Thus, as N becomes large, the probability of being penalized given the agent has not shirked, $p(\tilde{y}'=c_1|a_{FB})^N$ goes to zero, while the probability of receiving "salary" $\bar{s}(N)$ goes to one, with $\bar{s}(N)$ approximating the first-best payment. From inspection of condition (12), the improvement from increasing N is most dramatic when the agent's discretion (size of N) is small and gains from increasing N become quickly exhausted in that $\bar{s}(N)$ goes to the first-best payment very rapidly. As discussed below, however, this property will not always hold in general.

The first-best approximation is due to the fact that as N becomes large, a realization of $\underline{y}$ almost surely indicates that the agent has shirked, allowing the principal to associate larger penalties with a disclosure of c_1. Alternatively, if the agent doesn't shirk, $\underline{y}$ will almost surely never occur and any risk associated with a large penalty is minimized.[13]

To simplify the mathematics employed to find the result above, it was assumed that conditional on the agent's action, the signals of the various information sources are independent and identically distributed. Near first-best settings for appropriately large N may also result when the restriction that the signals be identically distributed conditional on a is dropped.[14] The policy used would be similar to that above in that it would assign punishments for an appropriately unfavorable disclosure and a salary otherwise. The simple convergence measure found above, $1/N$, however, would no longer exist, because signals will differ in their marginal informativeness as they are sequentially added.

If, however, conditional on a, most of the signals are highly correlated, a simple success/failure policy may not work efficiently because correlated signals may convey less information (consider the extreme case where the y's are perfectly correlated).

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[13] In practice, the ability to sufficiently penalize the agent depends upon the assumption of risk-aversion. That is, potential monetary losses must reduce utility by more than equal monetary gains increase utility. To achieve this paper's *single-period* result, this differential (monetary increases vs. monetary decreases) must be sufficiently large particularly if there exists (institutionally) a minimum compensation floor above which the agent must be compensated. Because the results in section III are near first-best, however, it would appear as though these results could be easily extended to a multiperiod setting (i.e., eliminate shirking problems in all periods). This requirement would be met in a multiperiod setting if the penalty associated with being dismissed were sufficiently high. For example, dismissal might mean the loss of deferred compensation (see, e.g., Lazear 1981), or extensive search costs.

[14] Let $\underline{y}$, as before, represent the event corresponding to the most unfavorable signal (that set of y's for which $p_a(y'|a^*)/p(y'|a^*)$ take the minimum value). Then a sufficient condition for this result is that $P_a(\underline{y}|a^*,N)/P(\underline{y}|a^*,N)$ (again defined as before) $\rightarrow -\infty$ as $N\rightarrow\infty$.

When the signals are highly correlated, a report implying that all of them are low-valued is much less informative about effort than such a report would be when they are conditionally independent. However, when groups of signals are correlated, and N becomes large, there may be enough signals to create families of signals, each of which conveys information incremental to the other families. An effective success/failure contract might be found, for example, by allowing a single signal from each family to be in the reportable set.

Finally, other compensation/investigation arrangements may work as well or be superior to the one presented in this section. For example, only a small amount of information has been used by this policy, and more complicated policies using more information could perform even better. The major point made here is that very uncomplicated mechanisms can accomplish nearly first-best results when an internal audit function is present. To illustrate this point consider the following example.

Example

A risk-neutral principal employs an agent whose preferences are $U(s)-V(a)=\ell n(s)-a$. There are two possible actions, $a_1=1$ (with a disutility of one), and $a_2=0$. The outcomes are such that the principal prefers to induce a_1. There is a monitor which reports "high" or "low."[15] Conditional on act a_1, the high signal is produced with probability 3/4. If the act is a_2, the probability of a high signal is 1/2. The agent's required minimum expected utility, H^*, is zero. Let $\bar{s}$ and $\underline{s}$ represent the amount paid to the agent when the high and low signals are produced. The contract must obey:

$$(3/4)\ell n(\bar{s})+(1/4)\ell n(\underline{s})-1\geq(1/2)\ell n(\bar{s})+(1/2)\ell n(\underline{s})-0 \qquad \text{(constraint (3))}$$

$$(3/4)\ell n(\bar{s})+(1/4)\ell n(\underline{s})-1\geq 0. \qquad \text{(constraint (2))}$$

The above will be equalities (otherwise the principal is either overpaying or imposing too much risk on the agent). Solving the two equations:

$$\underline{s}=e^{-2},\ \bar{s}=e^{2}.$$

The expected cost to the principal is:

$$(3/4)e^{2}+(1/4)e^{-2}=5.5756.$$

Next, suppose that a second monitor exists that generates an additional independent signal with the same probabilities as the first one. Let the agent choose which signal of the two monitors on which his or her compensation will be based. The equations are now:

$$(15/16)\ell n(\bar{s})+(1/16)\ell n(\underline{s})-1=(3/4)\ell n(\bar{s})+(1/4)\ell n(\underline{s})-0 \qquad \text{(constraint (3))}$$

$$(15/16)\ell n(\bar{s})+(1/16)\ell n(\underline{s})-1=0. \qquad \text{(constraint (2))}$$

The solution is $\underline{s}=e^{-4}$, $\bar{s}=e^{4/3}$, with the principal's expected cost equal to $(15/16)e^{4/3}+(1/16)e^{-4}=3.5577$. When third and fourth monitors are added, the principal's expected cost becomes 3.0867 and 2.8943, respectively. After the seventh monitor has been added, the expected cost to the principal is 2.7396. The first-best expected cost to the principal is a wage, s, where $\ell n(s)=1$, or $s=2.7183$. In this example, the principal's expected cost declines with the addition of monitors, but does so at a decreasing rate. As N increases, $\bar{s}\rightarrow 2.7183$, and $\underline{s}\rightarrow 0$. Note (1) that this result has been obtained with a very simple contract that has used only a small fraction of the available information, and (2) the absence of a minimal pay constraint allows for the first-best result. That is, if $\underline{s}$ were required to be larger than s_o, where $s_o>0$, such a result may not be possible.

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[15] The actual information system underlying the monitor may produce more than two signals. All that is required is that these signals can be subdivided into two subsets, "high" and "low."

IV. Internal Auditing Not Used for Performance Evaluation: Case B

Suppose that the only individual available to objectively verify information is the external auditor. If financial reports are the only available information useful for the provision of incentives, compensation will be based on those reports. A frequent criticism of financial report-based compensation is that managers are often able to manipulate financial reports for the purely self-interested reason of maximizing compensation. However, in the context of this paper, what might appear to be dysfunctional behavior could really be an optimal response to a well-designed compensation structure, even when it is done at the last minute (immediately before financial statements are issued).

In terms of the model presented in section II, N can be reinterpreted to designate the financial reporting alternatives available under GAAP. Because the alternatives are typically limited, the dimension of the y-vector, N, becomes smaller relative to that of the internal audit setting. The "payment schedule approximating an instruction" described in the previous section may no longer yield near first-best solutions, because the probability of a low-valued disclosure given a small N (say, e.g., two), is much more likely when the agent has worked hard than that of a low-valued disclosure when N is very large, and to impose large penalties for low-valued disclosure might impose unacceptable risk on the agent. Consequently, more complicated contracts may be required. It is shown below that it still may be profitable for the principal to allow the agent to choose a signal (or, in the context of this section, choose an allowable reporting alternative). In addition, the signals corresponding to GAAP alternatives are typically highly correlated conditional on a. This might also serve to reduce incentive effectiveness relative to the internal audit setting studied above.

Let the conditional probability of y^i and (y^i,y^j) be denoted $p(y^i|a)$ and $p(y^i,y^j|a)$, respectively. To represent the above, it will not be required that each signal be conditionally independent. Rather, SMLRP will be assumed which implies that each signal be "marginally informative" with respect to all other signals:

Definition: The signal from alternative j is marginally informative with respect to the signal from alternative i if:

$$\frac{p_a(y^i,y^j|a)}{p(y^i,y^j|a)}\neq\frac{p_a(y^i|a)}{p(y^i|a)}$$

for each y^i, the lowest and highest values of y^j, and each a.

The definition above says merely that given any signal from alternative i, another extreme signal from alternative j will be informative, because the probability inference associated with both signals is different from that associated with the single signal from alternative i. This condition is fulfilled whenever SMLRP holds.

Let the terms "inflexible policy" denote a policy in which the principal requires the agent to employ a particular prespecified GAAP alternative, and "flexible policy" denote one that allows the agent to make an observable choice from the set of GAAP alternatives.

Proposition: Suppose $N>1$, and each alternative i possess the SMLRP and CDFC properties described in section II. Then a flexible policy strictly Pareto dominates an inflexible policy.

Proof: Appendix A.

The proof of the Proposition makes use of the fact that under the inflexible policy, the resulting *ex ante* commitment to using a single signal (or GAAP alternative) requires the principal to discard all information contained in the signals not designated for contracting. Using an argument similar to the one used in the previous section, a flexible policy contract is designed that allows the agent to escape punishments associated with low realizations of the inflexible policy's prespecified monitor by permitting the agent, in such cases, to switch to a "better" signal.

Note that the setting studied above is a single-period one and because the information is used solely for contracting, flexibility is introduced only to improve incentives. By construction, there is no need in this setting for information concerning the financial position of the firm at the end of the period—the firm ends at the end of the period, and the principal (owners) consume $x-s$. *Ex post*, the agent chooses between alternatives *only* to maximize compensation—at the (*ex post*) expense of the principal. However, what might appear to an outsider as attempt to manipulate compensation, could be, in fact, an optimal response to an *ex ante* well-designed compensation arrangement.

Also note that while the Proposition indicates gains to permitting flexibility, it does not necessarily imply the possibility of near first-best solutions—particularly when the signals for GAAP alternatives are highly correlated (see discussion in section III). It still may be possible, however, in some situations, to achieve near first-best solutions, *even* under the inflexible policy. For example, consider the case where (1) $N=1$ (or equivalently an inflexible policy), (2) the agent manages a diversified company of L divisions, and (3) the prespecified accounting measure on which he or she is evaluated is the sum of the profits calculated for each division. Similar to Aron (1988), suppose that each division, k, produces random outcome $\tilde{z}^k$ and the agent's influence on $\tilde{z}^k$ is represented by probability function $p(z^k|a)$—that is, the agent's effort simultaneously influences all divisions.[16] Suppose, as in section II, that conditional on a, each $\tilde{z}^k$ is iid. Then given assumptions similar to conditions (4) through (6), a result identical to section II is obtainable by penalizing the agent when the firm's reported income is sufficiently low (say Lz_1, where z_1 is the lowest value of z^k). In this case, having the agent manage a large number of divisions experiencing independently distributed random shocks effectively diversifies away compensation risk and benefits from a flexible policy evaporate because a prespecified accounting aggregate such as total income captures all necessary information.

As a final comment, suppose, contrary to the assumptions made in this paper, that the identity of the signal disclosed is not verifiable. For example, GAAP may permit alternative forms of admissible evidence, rules, conventions, or procedures for calculating profit, but some of the details concerning the alternatives are withheld.

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[16] Aron (1988) shows that diversification can produce better measures of a top manager's effort.

When the signal's identity is not verified, a contract of the form $s(y^i,i,N)$ is no longer feasible. Rather, a contract of the form, $s(c_j)$, must be used, where c_j is a possible value that a given disclosure may take. To make this setting meaningful, the notion of flexibility/inflexibility presented above is modified somewhat. In particular, it is assumed that if the principal decides upon inflexibility, the use of a given reporting alternative is ensured. That is, an inflexible policy carries with it an informational component: if alternative i is prespecified by the principal, the signal produced by alternative i must always be disclosed. Conversely, if a flexible policy is used, the principal has no assurance which alternative the signal came from. In this setting a flexible policy may be inferior to an inflexible policy because it loses too much information. For example, if $N=2$ and $\tilde{y}^1$ and $\tilde{y}^2$ have a high negative covariance conditional on action, a, the ability to motivate the manager might be lost when changing from an inflexible policy to a flexible one since low values of one signal are probably accompanied by high values of the other signal and the ability to punish the agent (i.e., provide incentives) is lost. The possibility of such a setting points to the importance of financial disclosures of details concerning accounting policies.

V. Related Literature

The general notion of a delegated monitor choice is introduced by Demski et al. (1984), who analyze a principal-agent setting in which the agent has access to a discrete number of monitors (information systems), one of which is selected by the agent to produce information used for his or her performance evaluation. Demski et al. assume that the monitor choice is made after the productive action of the agent is (privately) taken (i.e., there exists moral hazard), but *before* the realization of the monitor's signal.[17] They provide examples that show that strict economic gains can accrue to delegating the choice of the monitor to the agent. A necessary condition for this result is that the agent have information strictly superior to the principal at the time of the monitor choice. Thus, the publicly observed choice of the monitor serves to indirectly communicate information concerning the information privately observed by the agent.

This paper deals with the delegated choice of a monitor in a somewhat different setting. Since, in practice, the monitor choice can frequently be postponed until the end of the reporting period, it may be that the agent has a good idea as to what signal has been produced by that monitor. It is assumed here that the agent, in fact, knows what signal has been produced by each monitor in the available menu of monitors. Thus, instead of choosing over monitors, *per se*, the agent will be choosing over the actual signals, each of which is produced by a different monitor (alternative sources of information), making this setting more closely resemble one of report manipulation.

Unlike the Demski et al. setting, where the choice of monitors provides an indirect way to communicate information concerning the distribution of $\tilde{x}$, in this setting there is no demand for additional information about $\tilde{x}$ because x is not used for performance evaluation and has already been realized (and perhaps observed by the principal (also see fn. 7)). To the extent that the delegation studied here produces biased information, it has undesirable properties; however, to the extent that it allows the agent to escape penalties when they are not justified and bear penalties when they are justified, delegation has the potential benefits of reducing the risk premium required by the agent to work for the firm.

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[17] Melumad and Reichelstein (1987) analyze an extension of this model.

The setting studied is, on the surface, closely related to the "persuasion game" discussed by Milgrom (1981) and Grossman (1981). In the persuasion game, the agent in a market setting,[18] privately observes a vector of signals related to the quality of the product he or she is selling, and is asked to disclose some of this private information. If the allowed dimension of the disclosures, say M, is less than N, then the agent will reveal the M most favorable elements of the vector. The market, however, will meet this disclosure with "sophisticated skepticism" (see Milgrom and Roberts 1986), adjusting their beliefs for the bias in the signal.

The persuasion game is relevant to the setting studied here in that the agent chooses a single element of the realized y that maximizes compensation. Thus, the similarity between this paper and the persuasion game is established in that the agent chooses the most favorable signal. In particular, a report of the lowest possible signal is *relatively* much more informative than a higher signal (the higher signal may be accompanied by other low, unreported signals). The paper is different, however, from the persuasion game in that "favorableness" in the persuasion game is exogenously given; while in the principal-agent model "favorableness" (as far as the agent is concerned) is determined endogenously by the compensation schedule for the agent.

VI. Conclusion

This paper uses a principal-agent setting to study how an internal audit function can produce near first-best results. The quantity of verifiable information produced by the internal audit function is constrained by either the time an internal auditor can spend verifying evidence or the time that employees have available to make such evidence verifiable (e.g., time spent with paperwork). A policy is studied that takes into consideration both the limited resources available to the internal audit function and that contracts tend to be of a simple nature. To an outsider, this policy might appear to be an informal meeting between an internal auditor (or staff member) and a production employee (e.g., a cost-variance investigation meeting) in which a salaried employee is permitted to present a limited amount of documented evidence. The success of this policy is dependent, however, on the effectiveness of the internal audit function.

For settings in which internal auditors' independence is compromised, the above policy may not be successful, and incentives must be provided to employees using financial reports (which are certified by independent external auditors) and other publicly available information. Certain inadequacies of using financial reports as incentive devices may be mitigated by allowing the employee discretion over accounting alternatives. Such acts, however, may appear to outsiders to be income manipulations aimed solely at maximizing compensation.

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[18] Typically, the agent is a seller of a good of unknown quality. Any disclosures made are informative of that good's quality and, in turn, influence the market price.

Appendix A

Proof of Proposition

Designate the financial reporting alternative prespecified by the inflexible policy as $i=1$. Let $s(y^1,1)$ denote the optimal inflexible policy contract. The first-order conditions for the inflexible policy are:

$$1/U'(s(y^1,1))=\lambda+\mu p_a(y^1|a^*)/p(y^1|a^*),$$

which implies $\mu>0$ (otherwise the contract would be decreasing in y^i and eliciting zero effort, contrary to the assumption that $a^*>0$) and $s(y^1,1)$ strictly increasing y^1 by SMLRP. Let E_1 denote the event $\{y^1=c_1$, and $y^i\leq c_p$ for all $i\neq 1\}$, where $c_p<c_Q$, and E_2 denote the event $\{y^1=c_1$ and it is not the case that $y^i\leq c_p$ for all $i\neq 1\}$. Then it follows from SMLRP (see Milgrom 1981) that because event E_1 is "worse" news about effort a^* than E_2,

$$\frac{p_a(E_1|a^*)}{p(E_1|a^*)}<\frac{p_a(E_1\cup E_2|a^*)}{p(E_1\cup E_2|a^*)}=\frac{p_a(\tilde{y}^1=c_1|a^*)}{p(\tilde{y}^1=c_1|a^*)}<\frac{p_a(E_2|a^*)}{p(E_2|a^*)}, \tag{A1}$$

where $E_1\cup E_2$ denotes the event $\{E_1$ or $E_2\}$. To show that the inflexible policy is not optimal, create a new flexible policy contract $s^*(y^i,i)$ obeying:

$$\begin{aligned} s^*(y^i,i)=s_L^*<s(y^1=c_1,1) \qquad &\text{when } y^i\leq c_p \text{ and } i\neq 1;\\ &\text{or } y^i=c_1 \text{ and } i=1, \end{aligned} \tag{A2}$$

$$s(y^1=c_1,1)<s_H^*=s^*(y^i,i)<s(y^1=c_2,1) \qquad \text{when } y^i>c_p \text{ and } i\neq 1, \text{ and} \tag{A3}$$

$$s^*(y^i,i)=s(y^1,1) \qquad \text{when } y^i>c_1 \text{ and } i=1. \tag{A4}$$

Because $s_L^*<s_H^*$, the agent's maximizing behavior implies that s_L^* will be paid when $E=E_1$ and s_H^* will be paid when E_2 occurs. Using the approach of Holmström (1979), I *claim* (proof in Appendix B) that the values of $s^*(\cdot)$ can be chosen subject to conditions (A2) through (A4) such that (1) the expected utility of the agent remains unchanged while the action of the agent locally increases, and (2) the expected value of $x-s^*(\cdot)$ strictly increases (i.e., the principal's expected return strictly increases). This demonstrates that $s(y^1,1)$ was not optimal, demonstrating that a flexible policy strictly Pareto dominates the inflexible one initially hypothesized to be optimal.

Appendix B

Proof of Claim made in Appendix A

Let $s_L^*\equiv s(y^1=c_1,1)-\alpha\delta_1$ and $s_H^*\equiv s(y^1=c_1,1)+\alpha\delta_2$ where $\alpha\geq 0$, δ_1, $\delta_2>0$, and δ_1 and δ_2 obey:

$$-\delta_1 p(E_1|a^*)+\delta_2 p(E_2|a^*)=0. \tag{B1}$$

Let $EG[\alpha,\hat{a}(\alpha)]$ and $EH[\alpha,\hat{a}(\alpha)]$ denote expected utilities of the agent and principal, respectively, contingent, on α, and the agent's optimal response to α, denoted $\hat{a}(\alpha)$. For $\alpha=0$ (letting subscripts denote partial derivatives):

$$\begin{aligned} d/d\alpha\{EH[\alpha,\hat{a}]\}|_{\alpha=0}&=EH_1[\alpha,\hat{a}]|_{\alpha=0}+EH_2[\alpha,\hat{a}][d\hat{a}(\alpha)/d\alpha]|_{\alpha=0}\\ &=EH_2[0,a^*][d\hat{a}(0)/d\alpha], \end{aligned} \tag{B2}$$

because condition (B1) implies $EH_1[0,a^*]=0$. At $\alpha=0$,

$$\begin{aligned} d/d\alpha\{EG[\alpha,\hat{a}]\}|_{\alpha=0} &= EG_1[\alpha,\hat{a}]|_{\alpha=0}+EG_2[\alpha,\hat{a}][d\hat{a}(\alpha)/d\alpha]|_{\alpha=0} \\ &= EG_1[0,a^*], \end{aligned} \tag{B3}$$

because the agent's first-order condition for effort implies $EG_2[0,a^*]=0$. However, $EG_1(0,a^*)=U'(s(y^1=c_1,1))[-\delta_1 p(E_1|a^*)+\delta_2 p(E_2|a^*)]=0$ because of definition (B1), implying small changes in α leave the agent's expected utility unchanged. The

$$\text{sign}[d\hat{a}(\alpha)/d\alpha]|_{\alpha=0}=\text{sign}[EG_{21}[\alpha,\hat{a}(\alpha)]|_{\alpha=0}. \tag{B4}$$

This comes from totally differentiating the agent's first-order condition, $EG_2[\alpha,\hat{a}(\alpha)]=0$ to get $EG_{21}[\alpha,\hat{a}(\alpha)]+EG_{22}[\alpha,\hat{a}(\alpha)][d\hat{a}(\alpha)/d\alpha]=0$. However, $EG_{22}[\alpha,\hat{a}(\alpha)]|_{\alpha=0}<0$ (agent's second-order condition), implying the above.

$$EG_{21}[\alpha,\hat{a}(\alpha)]|_{\alpha=0}=U'(s(y^1=c_1,1))[-\delta_1 p_a(E_1|a^*)+\delta_2 p_a(E_2|a^*)]. \tag{B5}$$

From condition (B1), $\delta_2=\delta_1 p(E_1|a^*)/p(E_2|a^*)$. Substituting this into the right-hand side of condition (B5) and multiplying the right-hand side of condition (B5) by $1/p(E_1|a^*)$, the right-hand side of condition (B5) becomes:

$$U'(s(y^1=c_1,1)\delta_1\left[\frac{p_a(E_2|a)}{p(E_2|a)}-\frac{p_a(E_1|a^*)}{p(E_1|a^*)}\right]>0 \tag{B6}$$

by condition (A1), implying that condition (B5) is strictly positive, or that the sign in condition (B4) is positive. The first-order conditions derived in Appendix A for the inflexible policy imply that multiplier, $\mu>0$, which implies that $EH_2[0,a^*]>0$ (see Holmstrom's (1979) explanation of his Proposition 1—the principal would desire more effort at the optimal solution for the inflexible policy). Combining sign[(B4)]>0 and $EH_2[0,a^*]>0$ establishes that condition (B2) is strictly positive, which implies the principal is strictly better off by increasing α from $\alpha=0$. Thus, the inflexible policy is not optimal because a flexible policy strictly Pareto dominates it. This completes the proof of the claim.

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Econometric Properties of Asset Valuation Rules Under Price Movement and Measurement Errors: An Empirical Test

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SYNOPSIS: Prior research has developed some econometric properties of accounting valuation rules as linear aggregations of prices and quantities. This study evaluates these proposed properties using actual price data and published price indexes for industrial machinery and equipment for the time period of 1973-1980.

Current order prices for 4,875 new industrial machinery and equipment assets were obtained from commercially published pricing guides. The order prices were then used to construct a set of composite price indexes. The Bureau of Labor Statistics (BLS) Producer Price Indexes were also obtained. Various sized asset portfolios were simulated, and the changes in their values were estimated using both the constructed and the BLS price indexes. The changes in estimated and actual values of the simulated portfolios were compared to generate both Bias and mean-squared-error (MSE) measures resulting from the use of price indexes under various experimental conditions. These error measures were then used to evaluate the econometric properties proposed by earlier studies.

In addition, total valuation errors were decomposed into movement and measurement components. Movement error is the valuation error attributable to deviations of the relative weights of assets used in constructing price indexes from those of the firm's asset portfolio. Measurement error is the valuation error arising from pricing errors, substitution bias, and

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inadequate adjustments for technological or quality changes in constructing price indexes.

The main results indicate that (1) movement error Bias is zero, but measurement error Bias is nonzero; (2) both MSE movement error and MSE measurement error decline with the use of increasingly fine index systems and with the holding of more diversified asset portfolios, but increase as the asset holding period lengthens; and (3) measurement error tends to be the major source of total error. These findings are based on an assumption that the order prices taken from the commercial pricing guides are void of significant measurement error.

Based on these results, it appears that additional effort should be devoted to enhancing price index construction techniques so that measurement error is decreased. Because portfolio diversification appears to reduce all components of error, asset valuations based on a price-index methodology should, perhaps, be restricted to cases involving larger groups of assets rather than very specialized strata of assets. Also, it may be appropriate to restrict the use of price indexes to assets of certain ages, as the study findings indicate that longer asset holding periods are associated with larger errors.

Key Words: *Current Cost, Measurement Error.*

Data Availability: *The price data and simulation programs used in this study are available from the authors.*

SUNDER (1978) and Lim and Sunder (1987a, 1987b) developed econometric analyses of the properties of accounting valuation rules by modeling the rules as linear aggregations of prices and quantities. These prior studies focused on the ability of various valuation rules to approximate the unobserved economic value of firms' portfolios of assets. Mean-squared-error (MSE) between alternative estimators (valuation rules) and the unobserved principal (the economic value) was used as an inverse measure of accuracy. Lim and Sunder (1987b) concluded that the relative properties of valuation rules are functions of the economic environments in which the rules are applied. They suggested that the debate on the relative merits of valuation systems cannot be fruitfully pursued in the abstract but must be assessed in the context of specific economic environments.

The present study evaluates several analytical results developed in those earlier studies and investigates the absolute econometric properties of valuation rules using data from a specific economic environment. Analytical formulations developed by Lim and Sunder (1987b) are used as a theoretical base, and hypotheses are tested regarding the (1) decomposability of total error, (2) error effects of increasing price index system fineness, (3) error effects of asset portfolio diversification, and (4) error effects of asset holding period. In addition, the relative magnitudes of error components from a specific economic environment are investigated.

Findings suggest that total error is decomposable into movement error and measurement error. Total error decreases with the use of finer index systems and with more diversified asset portfolios. In contrast, total error increases as the asset holding period lengthens. In general, measurement error was found to dominate movement error.

The first section of this article discusses the motivation for the study. The second section describes the theoretical model that is the basis for the research hypotheses derived in section III. The fourth section presents the methodology of the study, and the fifth section presents results. Conclusions, limitations, and suggestions for future research are provided in the final section.

I. Motivations for and Contributions of the Study

The theoretical insights and empirical results provided in this article should be useful to researchers in accounting and economics by making contributions to the literatures on the (1) statistical theory of valuation, and (2) effects of valuation error on current cost data.

Statistical Theory of Valuation

Prior research on alternative valuation rules has attempted to develop a statistical theory of valuation by modeling accounting asset valuation rules as linear aggregations. Ijiri (1967, 1968) first suggested that the linear aggregation coefficient be used as a measure of how well a surrogate aggregation approximates the principal aggregation. Sunder (1978) adopted this econometrics approach and defined valuation rules as linear aggregations of prices and quantities. Next, Hall (1982), Sunder and Waymire (1983, 1984), Ijiri and Noel (1984), Casler and Hall (1985a, 1985b), Tippett (1987), and Shih and Sunder (1987) used the linear aggregation model to examine the relative accuracy and efficiency of various valuation rules.

These studies share two major limitations. First, each was either based on hypothetical asset price changes or used price index information as a surrogate for asset price changes. Actual price data were not used in any of the studies and, therefore, measurement (i.e., pricing, technological change, etc.) errors were assumed to be zero. Thus, the studies investigated only the effects of movement (i.e., asset mix) error on the accuracy of valuation rules. The second common limitation is that each of the studies measured relative valuation error, assuming that asset portfolios were held for a single period (i.e., one year). No attempt was made to judge the extent of cumulative relative valuation error after holding an asset portfolio for a number of years.

The next significant extension of the literature was the use of actual price data and various asset holding periods by Shriver (1986, 1987). He examined the absolute accuracy of alternative valuation rules and also investigated the sources and sign of the total valuation error for diverse industrial machinery and equipment assets over two different time periods. His results are limited, however, since he did not allocate total valuation error into separate movement error and measurement error components, and he focused primarily on individual assets instead of asset portfolios.

Lim and Sunder (1987a, 1987b) subsequently integrated the prior analytical research on relative movement error with the recent empirical research on absolute total error to produce a more complete theoretical framework of the econometric properties of asset valuation rules. Their study combined both movement and measurement error into a single framework and facilitated direct comparisons of a variety of valuation rules in specific economic environments. Lim and Sunder (1987b) concluded that the relative properties of valuation rules are functions of the economic environments in which the rules are applied. They suggested that the debate on the relative merits of valuation systems cannot be pursued fruitfully in the abstract but must be assessed in the context of specific economic environments.

One motivation for the present study is to conduct such an empirical analysis in a specific economic environment. The present research analyzes the Lim and Sunder (1987a, 1987b) analytical formulations about total error (and its components: movement and measurement errors) using actual price data from diverse industries over various time periods. Furthermore, by analyzing total error and determining which of its components is the larger source of error, this article establishes a basis for directing efforts aimed at reducing valuation error in future research.

Current Cost Data and the Effects of Valuation Error

The usefulness of current cost data continues to be a controversial issue. The Financial Accounting Standards Board (FASB) completed its seven-year experiment dealing with the financial reporting of changing prices in 1986 and issued Statement of Financial Accounting Standard (SFAS) No. 89 (FASB 1986). SFAS No. 89 eliminated the mandatory requirement for U.S. companies to provide current cost data but encouraged the continued voluntary reporting of the supplementary disclosures.

Although many prior studies concluded that current cost data lack relevance for certain decisions (reviewed in DeBerg and Shriver 1987), concerns have been expressed that these findings may have been due to the potential degrading of the information content of current cost data by valuation error (Beaver and Landsman 1983). Craig and Tippett (1987, 142) characterize the problem as follows:

> In many Western industrialized countries, official pronouncements have recommended the use of crude, imputed measurement devices for accounting in a period of changing prices. For example, the U.S.A.'s Financial Accounting Standards Board (FASB) in Statement of Financial Accounting Standards No. 33 (FAS 33), *Financial Reporting and Changing Prices*, and the U.K.'s Accounting Standards Committee (ASC) in Statement of Accounting Practice No. 16 (SSAP 16), *Current Cost Accounting*, have tended to pay lip-service to the measurement problems involved. Measurement methods permitted in such pronouncements appear to be justified (albeit implicitly in many cases) on the grounds of convenience and compromise; to be concerned with expedient rather than scientific solutions to measurement problems, and to be cloaked in an ill-fitting mantle of theoretical respectability.

Furthermore, Shalchi and Smith (1985) lament the lack of analytical and empirical research on those measurement issues.

A second motivation for the present study is to provide evidence that is helpful in judging the extent to which valuation errors affect current cost disclosures. Ultimately, this line of research should help resolve concerns about valuation errors by either demonstrating that they do not create a serious problem or by laying a foundation to foster more accurate valuations. Reductions in valuation error will enhance model construction and variables specifications in both incremental information content studies (e.g., Beaver and Landsman 1983), and income measurement studies (e.g., Haw and Lustgarten 1988).

II. Theoretical Model

The theoretical model developed by Lim and Sunder (1987b) and used as the framework for this study can be described as follows. Let:

$\underline{w}'$ = a row vector representing the relative weights of assets in a firm's portfolio at time 0, and

$\underline{r}$ = a column vector representing the unobserved true price relatives of all assets from time 0 to time 1.

Then the change in the valuation of the firm's asset portfolio for the time period is given by:

$$R=\underline{w}'\underline{r}, \tag{1}$$

where R is defined as the principal aggregate.

To model the estimation of this principal aggregate, Lim and Sunder (1987b) proposed the following structure. Without loss of generality, let:

$(\underline{\omega}^{k\ell})'$ = a partitioned row vector of economy-wide asset weights $(\underline{\omega}_1'/\underline{\omega}_2'/\ldots/\underline{\omega}_k')'$ where the partitions correspond to the groupings of n assets into k price indexes. The superscript ℓ refers to a specific way of partitioning n assets into k price indexes, and

$\underline{\tilde{r}}$ = a column vector representing, for all assets, the sum of the unobserved true price relatives and measurement error $(\underline{\epsilon})$ from time 0 to time 1.

Then, the estimated percentage change in the value of the firm's asset portfolio is given by:

$$\tilde{R}_{k\ell}=(\underline{\omega}^{k\ell})'\underline{\tilde{r}}. \tag{2}$$

Using the previous formulations, Lim and Sunder (1987b) define two economy-wide error metrics:

$$\text{Bias }(\tilde{R}_{k\ell})\equiv E(\tilde{R}_{k\ell}-R), \tag{3}$$

$$\text{MSE }(\tilde{R}_{k\ell})\equiv E(\tilde{R}_{k\ell}-R)^2,\text{ and} \tag{4}$$

E is the expected value operator over all possible measurement errors, price changes, and firms.

The model proposed by Lim and Sunder (1987b) also partitions the total error amount $(\tilde{R}_{k\ell}-R)$ into movement error and measurement error. Movement error is defined as the error of valuation that arises because the relative asset weights used in the construction of price indexes are not the same as the relative weights in firms' asset portfolios. Mathematically,

$$\text{Movement error}\equiv E(R_{k\ell}-R), \tag{5}$$

where:

$$R_{k\ell}=(\underline{\omega}^{k\ell})'\underline{r}, \tag{6}$$

$$R=\underline{w}'\underline{r},\text{ and} \tag{7}$$

E is the expected value operator over all possible price changes and firms.

Measurement error is defined as the error of valuation that arises due to sampling and non-sampling error in constructing price indexes (e.g., pricing errors, substitution bias, and inadequate adjustments for technological or quality change). Mathematically,

$$\text{Measurement error}\equiv E(\tilde{R}_{k\ell}-R_{k\ell}), \tag{8}$$

where:

$$\tilde{R}_{kt} = (\underline{\omega}^{kt})'\,\underline{\tilde{r}}, \tag{9}$$

$$R_{kt} = (\underline{\omega}^{kt})'\,\underline{r}, \text{ and} \tag{10}$$

E is the expected value operator over all possible measurement errors, price changes, and firms.

Utilizing this analytical formulation and invoking certain assumptions about the economic environment, Lim and Sunder (1987b) analyzed the econometric properties of MSE for various linear estimators. In doing so they developed a number of theorems and propositions. In part, the present study represents an empirical test of the assumptions underlying the Lim and Sunder (1987b) analytics.[1] In addition, this study extends prior empirical findings of Casler and Hall (1985a) regarding diversification effects on movement error and Shriver (1986) regarding the effects of asset holding period on total valuation error.

III. Hypotheses

Total Bias and MSE

The analytical framework specified by Lim and Sunder (1987b) defined total valuation error, as measured by Bias, as the sum of movement error and measurement error. Under an assumption that the expected value of individual measurement errors is zero and that firms are of equal size, Lim and Sunder (1987b) proved that total valuation error as measured by Bias should be zero and that each component of total error (movement and measurement error) also should be zero. They also demonstrated that total MSE could be partitioned into movement and measurement error.[2] That is,

$$\begin{aligned} \text{Bias} &\equiv E(R_{kt}-R)+E(\tilde{R}_{kt}-R_{kt}) \\ &= 0; \end{aligned} \tag{11}$$

and

$$\text{MSE} \equiv E(\tilde{R}_{kt}-R)^2 \tag{12}$$

$$= E(R_{kt}-R)^2+E(\tilde{R}_{kt}-R_{kt})^2. \tag{13}$$

To test the applicability of these results to the time period from which the study's data are drawn, the following hypotheses are specified:[3]

- H1: Total Bias = 0,
- H2: Movement Bias = 0,
- H3: Measurement Bias = 0, and
- H4: MSE of total error is equal to average squared movement error plus average squared measurement error.

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[1] Precluding mathematical error, the theorems and propositions developed in Lim and Sunder (1987b) are valid. However, the results of the theorems may not be applicable if the assumptions on which the theorems are based do not hold in a given economic environment. Hence, the present study represents a test of whether the assumptions made in Lim and Sunder (1987b) hold for the time period from which the study's data are drawn.

[2] Note that, in general, if $\tilde{Z} \equiv \tilde{X}+\tilde{Y}$, then $E(\tilde{Z}^2) = E(\tilde{X}+\tilde{Y})^2 = \bar{X}^2+\sigma_x^2+\bar{Y}^2+\sigma_y^2+2\,\text{Cov}(\tilde{X}\tilde{Y})$. Hence, the assumptions invoked by Lim and Sunder result in elimination of the covariance element between movement error and measurement error.

Index System Fineness

Sunder (1978) demonstrated that movement MSE declines with the use of increasingly fine index systems, provided that the price indexes are constructed from price data measured without error. This result occurs because the relative weights used in constructing the "finest" partition are closer to the relative weights of assets in the portfolios of individual firms. In contrast, Lim and Sunder (1987b) showed that measurement error should increase with the use of increasingly fine index systems. This result is dependent upon the assumption that the variance or standard deviation of price quotations (pricing errors) is the major quantifiable measurement error. Thus, the use of a more general index should diversify away the pricing measurement errors. To examine the applicability of these analytical findings, the following hypotheses are tested:

H5: MSE movement error is unaffected by the fineness of the index system used.
H6: MSE measurement error is unaffected by the fineness of the index system used.

Asset Portfolio Diversification

The Lim and Sunder (1987b) analytics suggest that valuation accuracy should improve with increasing asset portfolio diversification. In their formulation, diversification is a function of the ρ (rho) parameter. As ρ increases, the vector of asset proportions for individual firms becomes statistically closer to the economy-wide vector of asset proportions $\underline{\omega}$.

The results of Casler and Hall (1985a), using hypothetical price data, support this analytical theorem by demonstrating that MSE movement error declines as firms' portfolios become more diversified. Their study did not address measurement error, however, and measurement error may remain after diversification under certain conditions (Lim and Sunder 1987b). Therefore, to examine the applicability of this analytical proposition for both movement error and measurement error, actual price data are used to test the following hypotheses:

H7: MSE movement error is unaffected by the extent of diversification of firms' asset portfolios.
H8: MSE measurement error is unaffected by the extent of diversification of firms' asset portfolios.

Asset Holding Period

The Lim and Sunder (1987b) theoretical framework also suggested that valuation accuracy decreases over longer time intervals due to an increase in the expected value and variance matrix of price relatives (which should be larger for longer periods of time). A 1986 study of individual assets by Shriver found evidence to support this conclusion for total valuation error. To examine the applicability of this finding to asset

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[3] As described in the methodology section, the simulation routine assumes equal firm size. Hence, the hypotheses specified represent a test of assumptions regarding $E(\underline{\epsilon})$ and the covariance of movement and measurement errors.

portfolios and to partition the analysis between movement error and measurement error, the following hypotheses are tested:

H9: MSE movement error is unaffected by the length of the asset holding period.
H10: MSE measurement error is unaffected by the length of the asset holding period.

IV. Methodology

To test the hypotheses specified in the previous section, the following procedures were employed. First, the current order prices of a diverse set of new industrial machinery and equipment assets were obtained. Based on these actual asset prices, a number of price indexes (referred to hereafter as CPI) were constructed. Data regarding Bureau of Labor Statistics (BLS) Producer Price Indexes (PPI) also were obtained.

After various sizes of asset portfolios were developed using a simulation procedure, changes in the values of these portfolios were estimated using both the CPI and the BLS price indexes. These estimated changes in value were then compared to the actual changes to obtain error amounts resulting from the use of the price indexes under various experimental conditions. The resulting error amounts were then analyzed to test the hypotheses.

Asset Price Data

The asset price data were obtained from three issues of the *Industrial Machinery and Equipment Pricing Guide* (Land 1974, 1977, 1981). This pricing guide is compiled by experts in the industrial machinery and equipment field and reports the current order cost of approximately 5,000 specific assets.[4]

To test hypotheses H9 and H10 regarding the effects of the length of the asset holding period, price data at three dates (1973, 1976, and 1980) were obtained and compared. Data for 1973 and 1976 were used to obtain information regarding price changes for assets held for three years, while data for 1973 and 1980 were used to obtain information regarding price changes for assets held for seven years.

The collection of asset price data represented 4,875 assets. For analysis purposes, these assets were classified into five categories corresponding to BLS machinery and equipment subgroups: metalworking ($n=765$), general purpose ($n=1{,}851$), special industry ($n=832$), electrical ($n=994$), and miscellaneous ($n=433$). For the overall population, price changes for individual assets were quite diverse, ranging from -19 percent to $+500$ percent for the three-year time period and ranging from $+0$ percent to $+650$ percent for the seven-year time period.

Constructed Price Indexes (CPI)

Recall that one objective of the study was to provide information regarding movement error (hypotheses H2, H4, H5, H7, and H9). To obtain an estimate of movement error, it is necessary to compute the difference between the actual value of a portfolio and its estimated value obtained by applying a price index that does not contain measurement errors. With movement error defined as $E(R_{kt}-R)$, the values of R_{kt} and R must be known to obtain a measure of such error. The value of R_{kt} is the price index price relative, and the value R is the actual price relative for the firm's asset portfolio.

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[4] Because the experts who compile the guide have bought, sold, or appraised machinery and equipment for many years, the data reported in the guide are thought to be accurate. Thus, this study assumes that the Land prices are void of significant measurement error. To date, however, no study has been published that has tested the accuracy of the Land prices.

For each BLS subgroup, an estimated value of R_{kt} was developed by calculating the average actual price relative from the Land data. Mathematically,[5]

$$R^j_{1,1}=\frac{1}{n_j}\sum_i (P^1_{ij}-P^0_{ij})/P^0_{ij}, \tag{14}$$

where:

$R^j_{1,1}$ = price index price relative for asset subgroup j (j = metalworking, general, special, electrical, and miscellaneous),
n_j = number of assets in the jth subgroup,
P^1_{ij} = actual price of asset i in subgroup j at the end of the time period, and
P^0_{ij} = actual price of asset i in subgroup j at the beginning of the time period.

To develop an estimated price index representing the overall machinery and equipment group, the subgroup price relatives were combined into a weighted average using actual economy-wide weights (see U.S. Department of Labor 1981 for the subgroups used by the BLS in calculating its composite index for the overall machinery and equipment group). Mathematically,

$$R_{1,1}=\sum_j W_j R^j_{1,1}, \tag{15}$$

where:

W_j = the relative weight for subgroup j used by the BLS in calculating its composite index representing the overall machinery and equipment group, and
$R^j_{1,1}$ = price index price relative for asset subgroup j.

BLS Producer Price Indexes (PPI)

Actual BLS producer price indexes were used to calculate total error because they represent the most comprehensive collection of external price indexes for machinery and equipment and because they are the most frequently used indexes in measuring the current cost of new assets (Skousen and Albrecht 1984).[6] The BLS Producer Price Index

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[5] This calculation represents a simple average of the price relatives for assets in each respective subgroup. Preferably, the calculation would have weighted these price relatives by the asset weights used in constructing BLS price indexes, but this was not possible due to changes over time in the set of individual assets included in BLS price indexes and BLS use of a smaller sample of assets than represented by the Land data.

It should be noted that the constructed price indexes are surrogates for BLS indexes that have been reconstructed to eliminate measurement error. To the extent that the weights used in the constructed indexes vary from those used in the BLS indexes, the study's estimate of movement error resulting from the use of BLS indexes will be affected. Also, the partitioning of total error into movement and measurement error will be affected. Although there is no reliable way to assess the significance of this potential problem, a review of the actual weights used by the BLS for the approximately 700 assets included in the BLS indexes examined revealed that no one asset or group of assets dominated the weightings. Hence, an assumption of equal weights seems defensible.

[6] This study assumes that, compared to the constructed price indexes, the BLS indexes are much more likely to contain significant measurement error. As footnote 4 acknowledges, there are no known published

Table 1
Information Regarding *PPI* Subgroups and Composite Price Indexes

Panel A. Commodity Subgroups Included in Group 11 Machinery and Equipment:

Group Number	Subgroup Number	Description
11	1	Agricultural Machinery and Equipment
11	2	Construction Machinery and Equipment
11	3	Metalworking Machinery and Equipment
11	4	General Purpose Machinery and Equipment
11	6	Special Industry Machinery and Equipment
11	7	Electrical Machinery and Equipment
11	8	Miscellaneous Electrical and Electronic Instruments
11	9	Miscellaneous Machinery

Panel B. Various Composite Indexes Used in the Study and Related Identifying Name:

Identifying Name Used in the Study	*Reference Name*	*Composite Index Represents the Following PPI Subgroup(s)*
PPI†	Machinery and Equipment	Group 11, Subgroups 3, 4, 6, 7, 9
$PPI_{4,M}$	Metalworking Machinery and Equipment	Group 11, Subgroup 3
$PPI_{4,G}$	General Purpose Machinery and Equipment	Group 11, Subgroup 4
$PPI_{4,S}$	Special Industry Machinery and Equipment	Group 11, Subgroup 6
$PPI_{4,E}$	Electrical Machinery and Equipment	Group 11, Subgroup 7
$PPI_{4,O}$	Miscellaneous Machinery and Equipment	Group 11, Subgroup 9

series (PPI) reports price index data for 15 major commodity groups including the major commodity group of interest in this study—group 11 machinery and equipment. The machinery and equipment group is further subdivided into eight subgroups, each of which has a composite index that summarizes price changes for equipment in that subgroup. Panel A of table 1 provides a description of the machinery and equipment subgroups.

To provide a test of hypotheses H5 and H6, price indexes representing two levels of fineness were used. First, at the most specific level, a composite index corresponding to each of the five equipment subgroups listed earlier was used. These five indexes were assigned identifying references as follows:

$PPI_{4,M}$ = metalworking equipment index,
$PPI_{4,G}$ = general purpose equipment index,
$PPI_{4,S}$ = special industry equipment index,
$PPI_{4,E}$ = electrical equipment index, and
$PPI_{4,O}$ = miscellaneous (other) equipment index.

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tests of the extent of error in the Land prices, on which the constructed indexes are based. However, considerable economics literature suggests that BLS indexes may indeed contain significant error (see Early 1978; Popkin 1983; Triplett 1975).

At a lower level of fineness, the group 11 machinery and equipment composite index was used. The machinery and equipment composite index, which reports the combined price movements of all machinery and equipment, was identified as PPI_3. By comparing error amounts resulting from use of the various PPI_4 versus use of PPI_3, hypotheses H5 and H6 regarding index system fineness were tested.

As described earlier, the asset price data collected via field studies were classified to correspond to BLS subgroups. Because the Land pricing guide used as the basis for collection of actual price data did not encompass all machinery and equipment included in the BLS producer price index series, BLS subgroups representing agricultural, vehicular construction, and miscellaneous electronic assets were not included in the study. As a result, the study used only those BLS subgroup price indexes representing assets included in the Land pricing guide (i.e., metalworking, general purpose, special industry, electrical, and miscellaneous machinery and equipment) and a modified group price index representing all five subgroups. The modified group index was calculated using the actual subgroup indexes and actual weights used by the BLS to combine subgroup indexes into an overall group index. Mathematically,

$$PPI_3^* = \sum_j W_j PPI_{4j}, \tag{16}$$

where:

PPI_3^* = BLS group 11 price index adjusted to include only the metalworking, general, special, electrical, and miscellaneous subgroups,
W_j = the relative weight for subgroup j used by the BLS in calculating its machinery and equipment group index, and
PPI_{4j} = actual price index for subgroup j.

Thus, the study used two alternative levels of fineness. The two levels, listed in ascending order of fineness, are PPI_3^* and $PPI_{4,j}$ ($j = M, G, S, E$, or O, depending on the type of equipment held in the portfolio). Panel B of table 1 summarizes the various composite indexes used in the study.

Simulated Asset Portfolios

To investigate the relationship between portfolio diversification and valuation error as specified in hypotheses H7 and H8, asset portfolios were constructed assuming various levels of diversification. The level of diversification was measured by the number of different assets held (N), which varied from 1 to 100. Restricting portfolios to a maximum of 100 assets presented no significant limitation because trends in error values were well established once 100 assets were held.

To simulate these asset portfolios, all assets were first assigned a unique reference number in the range of 1 to 4,875—metalworking (1,2,. . .,765), general purpose (766,767,. . .,2,616), etc. Then, for each simulated firm holding N assets, N random numbers from the range of 1 to 4,875 were drawn without replacement. These random numbers were used to represent the specific assets held by the firm.

The relative weight of each asset in a firm's portfolio was determined using a four-step sequence of procedures designed to ensure that, on a cross-sectional basis, simulated asset portfolios reflected economy-wide subgroup weights identical to those used by the BLS. The first step involved drawing, for each asset held by a hypothetical firm, a random number from the range of 1 to 100. This random number represented a preliminary measure of the asset's magnitude in the portfolio. Then, based on the asset's reference number (1 to 4,875) the asset was identified as belonging to a specific subgroup. A final measure of the asset's magnitude was calculated as the product of the preliminary measure and a numerical factor that would result in an appropriate economy-wide weight for all assets in that particular subgroup.[7] In each firm, these final measures of assets' magnitudes were totaled and then used to calculate that firm's asset weighting vector.

Determination of Valuation Error

For each simulated firm, valuation error resulting from the use of a price index to estimate the value of the firm's asset portfolio was calculated by comparing the actual price relative of its asset portfolio to a price relative estimated from an index or indexes. Mathematically,

$$E_i = \tilde{R}_{kt} - R, \tag{17}$$

where:

E_i = the valuation error for firm i arising from the use of an index or indexes to estimate the portfolio's value, and

$\tilde{R}_{kt}$ = the estimated price relative of the asset portfolio held by firm i. If based on only one price index, this was simply the price relative for that index for the study time period. If based on the five subgroup composite indexes, $\tilde{R}_{kt}$ was calculated as the average of each subgroup price index relative weighted by the firm's asset holdings in each subgroup.

This total error then was partitioned into movement error and measurement error as follows. First, for each portfolio, E_i was estimated using either PPI_3^* or PPI_4. This provided a measure of total error. Next, E_i for the same portfolio was recalculated using the corresponding CPI indexes ($R_{1,1}$ if PPI_3^* was used to estimate total error, and $R'_{1,1}$ if PPI_4 was used to estimate total error), which yielded a measure of movement error. Finally, the latter error was subtracted from the first to obtain an estimate of measurement error. These error measures were used to determine average Bias and average squared error.

For each level of diversification ($N = 1, 2, \ldots, 100$), 200 independent replications were made resulting in 200 portfolio-specific measures of total, movement, and measurement error. At each level of portfolio diversification the same 200 asset portfolios were used for every combination of portfolio holding period and number of price indexes. Thus, the error values were analyzed as a $2 \times 2 \times 2$ fully factorial repeated measure design with all ANOVA factor effects assumed to be fixed.

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[7] As an example, if the asset's reference number was 500, then that asset was identified as belonging to the metalworking subgroup. Based on the preliminary simulation process, metalworking assets would have a cross-sectional weight of 15.7 percent (765 ÷ 4,875) but the BLS weight for metalworking assets for the time period of the study was 11.4 percent. Thus, to ensure that simulated metalworking assets had the appropriate cross-sectional weight of 11.4 percent, the initial random numbers representing metalworking assets' magnitudes were multiplied by .726 to obtain the desired cross-sectional weight. Similar procedures were used in each equipment subgroup.

Table 2
Error Amounts Averaged Over All Study Observations and Significance Levels of Tests That Average Errors=0

	Average Error	Observed Significance Level of Test That Average Error=0
Panel A. Bias:		
Total	0.1317	0.0001
Movement	−0.0002	0.5235
Measurement	0.1319	0.0001
Panel B. MSE:		
Movement	0.0090	n/a
Measurement	0.0224	n/a
Movement + Measurement	0.0314	n/a
MSE of Total Error	0.0312	n/a
Difference	0.0002	0.2337

n/a = Test not applicable.

V. Results

Bias Error

Table 2 reports mean error amounts averaged over all observations. Panel A of table 2 reports total, movement, and measurement Bias error and the observed significance levels (OSL) of tests that these Bias error amounts equal zero. For these data, total Bias averaged 0.1317, which is significantly different from zero.[8] Hence, hypothesis H1, that total Bias equals zero is rejected.

Movement Bias averaged −0.0002, which is not significantly different from zero. Based on this evidence, hypothesis H2, that movement Bias equals zero, is not rejected. Additionally, panel A of table 2 shows that measurement Bias averaged 0.1319, which is significantly different from zero. Thus, hypothesis H3, that measurement Bias equals zero, is rejected.

These results suggest that, for the time period from which the data were drawn (1973–1980), the assumption that $E(\epsilon)=0$ does not hold. Rather, the results provide significant evidence of nonzero total Bias and measurement Bias for a specific economic environment. This measurement error Bias may be due to pricing errors, substitution Bias, or inadequate adjustments for technological or quality change in PPI construction.[9]

[8] For purposes of this study, a statistical test was considered to be significant if the observed alpha level was .01 or less.

[9] The finding of a significant measurement error Bias is consistent with two economic interpretations of recent research. One potential source of the measurement error may be pricing or sampling errors (Shriver 1987). The BLS (1981) obtains price quotations for index construction from trade publications or manufacturers on a voluntary and confidential basis. The nominal price quotations submitted to the BLS may not repre-

Table 3
Average Squared Error Values for Factor Combinations

	Factor		*Average Squared Error*		
Number of Indexes Used	*Number of Assets Held*	*Holding Period in Years*	*Total*	*Movement*	*Measurement*
Panel A					
1	*	*	0.0314	0.0093	0.0225
5	*	*	0.0310	0.0089	0.0222
	Percentage Change in Magnitude of Average Error		−1%	−5%	−2%
	OSL of Test That Change is Zero		0.0002	0.0001	0.0001
Panel B					
*	1	*	0.1562	0.1288	0.0321
*	100	*	0.0234	0.0018	0.0218
	Percentage Change in Magnitude of Average Error		−85%	−99%	−32%
	OSL of Test That Change is Zero		0.0001	0.0001	0.0001
Panel C					
*	*	3	0.0097	0.0054	0.0043
*	*	7	0.0527	0.0126	0.0405
	Percentage Change in Magnitude of Average Error		+443%	+132%	+850%
	OSL of Test That Change is Zero		0.0001	0.0001	0.0001

* Averaged over factor indicated.

Divisibility of MSE Total Error

Panel B of table 2 reports that MSE movement and measurement error averaged 0.0090 and 0.0224, respectively. These two error components sum to a value of 0.0314, while the average MSE of total error was 0.0312. The difference between these latter two values is not statistically different from zero. Thus, hypothesis H4 is not rejected, suggesting that total MSE may be partitioned into movement error and measurement error as proposed by Lim and Sunder (1987b). This finding suggests that the Lim and Sunder (1987b) assumption that movement errors and measurement errors are uncorrelated is empirically supportable.

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sent the current order cost of the assets, because of reliance on antiquated price lists in some circumstances or lack of conscientious compliance in other situations.

A second potential source of the measurement error may be an overstatement bias in the PPI attributable to substitution Bias and inadequate adjustments for technological or quality change (Swanson and Shriver 1987). The PPI are based on a Laspeyres index construction (fixed weight formula), and a potential upward bias of estimation exists when the substitution of less expensive goods with the same quality is not reflected in the PPI. In addition, any failure to ascertain the technological or quality change embodied in new assets imparts an upward bias to the PPI.

Index System Fineness

Data presented in panel A of table 3 indicate that using five subgroup indexes instead of one overall index yielded lower MSE error amounts, though the reductions in error tended to be minimal. Total MSE declined one percent from 0.0314 to 0.0310, while movement MSE and measurement MSE declined five percent and two percent, respectively. These changes, due to using a finer index system, were all statistically significant.

These results indicate that both hypotheses H5 and H6, that MSE error is unaffected by fineness of the index system used, should be rejected. It appears that both MSE movement and MSE measurement error decline with the use of increasingly fine index systems, though the reduction in error is small.

The reduction in movement error is consistent with the Lim and Sunder (1987b) analytical formulations. In contrast, the reduction in measurement error differs from their analytical findings. Lim and Sunder (1987b) assumed that the variance of price quotations (pricing errors) constitutes the major source of measurement error. Thus, the use of a more general index should diversify these pricing errors away. It appears, however, that the significant measurement error Bias cannot be diversified away by using a more general index. Hence, in this study, the "finer" index system apparently possesses less measurement error than the more general index (see fn. 9).

Asset Portfolio Diversification

Previous findings reported in Casler and Hall (1985a) and the analytical formulations of Lim and Sunder (1987b) have suggested that MSE movement error declines as portfolios become more diversified. Data presented in panel B of table 3 support this conclusion and further suggest that the effects of diversification are greatest for MSE movement error, followed by MSE measurement error. For example, MSE movement error declined 99 percent (from 0.1288 to 0.0018) as a result of increasing the portfolio size from $N=1$ to $N=100$, while MSE measurement error declined 32 percent (from 0.0321 to 0.0218).

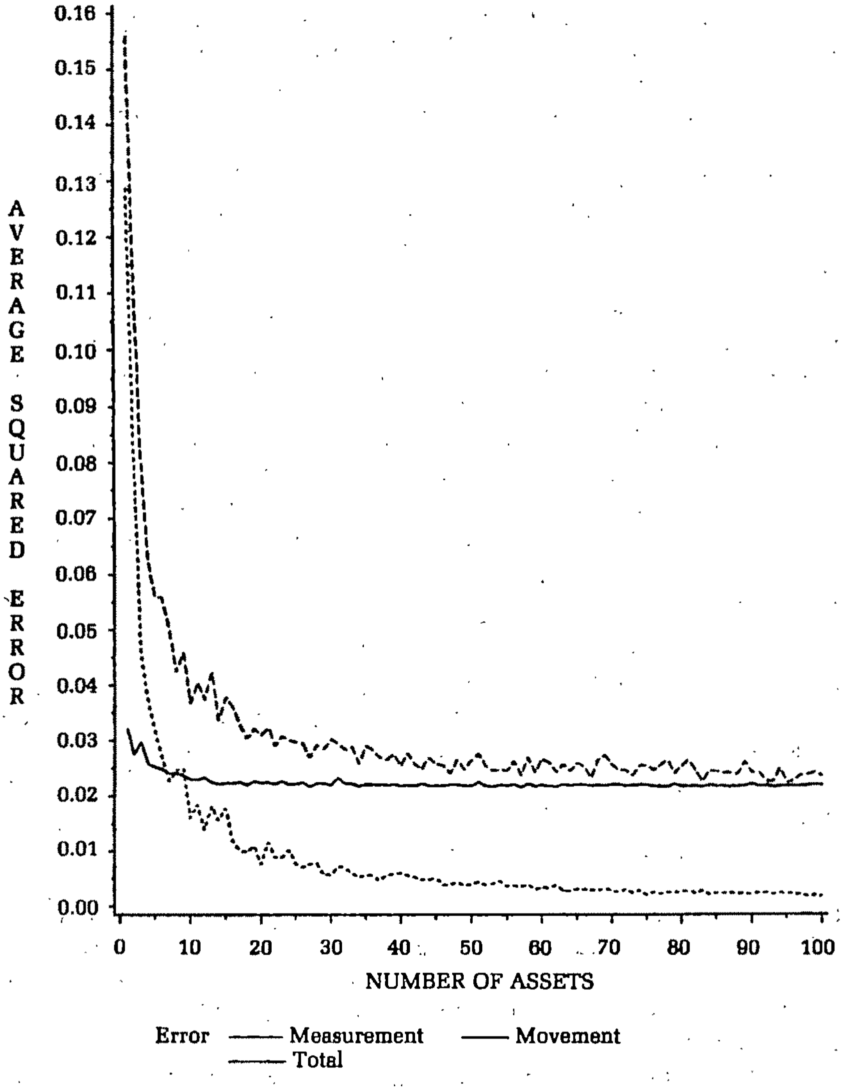
Statistical analysis reveals that variations in portfolio diversification resulted in statistically significant differences in MSE error averages. However, these test results merely indicate that at least one average error at a given portfolio size was significantly different than the average error at another (unspecified) portfolio size. To confirm that average errors tended to decline as portfolio sizes increased, regression analyses were performed wherein each type of MSE error (total, movement, and measurement) was regressed on portfolio size. In each of these three regressions, the coefficient of the portfolio size variable had the expected sign (negative) and was statistically significant.

Although the study examined portfolios that ranged in size from one to 100, the data presented in table 3 were confined to portfolios of size one and 100 to conserve space. To supplement the data in table 3, figure 1 presents plots of MSE error values averaged over each possible holding period and number of indexes used for each size portfolio. Data presented in figure 1 indicate that most reductions in error were achieved once ten assets were held.

On the basis of these results, hypotheses H7 and H8, that increased portfolio diversification does not affect MSE error, are rejected. Thus, both MSE movement error and measurement error appear to be reduced by asset portfolio diversification, as suggested in Lim and Sunder (1987b).

Figure 1

Plots of Average Squared Error Versus Number of Assets



Asset Holding Period

Consistent with Shriver's (1986) study concerning individual assets and the Lim and Sunder (1987b) analytical formulations, data presented in panel C of table 3 demonstrate that lengthening the asset portfolio holding period dramatically increases MSE for asset portfolios of various sizes. Also, these increases were most pronounced for measurement error followed by movement error. For example, when the asset holding period was increased from three to seven years, measurement error increased 850 percent (from 0.0043 to 0.0405), while movement error increased by 132 percent (from 0.0054 to 0.0126). Analyses indicated that these differences were statistically significant and, therefore, hypotheses H9 and H10, that MSE error is unaffected by the length of

Table 4
Average MSE Measurement Error as a Multiple of Average MSE Movement Error

Number of Indexes Used	*Number of Assets Held*	*Holding Period in Years*	*Average MSE Measurement Error as a Multiple of Average MSE Movement Error*
1	1	3	0.1
1	1	7	0.2
1	100	3	4.1
1	100	7	15.4
5	1	3	0.1
5	1	7	0.4
5	100	3	3.6
5	100	7	16.2

the asset holding period, are rejected. Hence, both MSE movement error and measurement error appear to be increased by longer asset holding periods, as suggested by Lim and Sunder (1987b).

Relative Magnitude of Measurement and Movement Error

Table 4 provides information about the ratio of average MSE measurement error to average MSE movement error using one and five indexes for three- and seven-year holding periods for portfolios of size N=1 and N=100. A review of table 4 discloses that measurement error tends to be less than movement error at N=1, but at N=100, measurement error is larger than movement error. For example, when using one index to value a portfolio held three years, the multiples are 0.1 and 4.1 at N=1 and N=100, respectively.

Data presented in table 4 also suggest that the longer the holding period, the larger the multiple. For example, using one index to value portfolios of N=1, the multiples are 0.1 and 0.2 for three- and seven-year holding periods, while at a portfolio size of N=100, the multiples are 4.1 and 15.4, respectively.

Concerning the effects of using more indexes, no general pattern is apparent. Using more indexes reduces the multiple in some cases but increases the multiple in others. In summary, it appears that, for the time period from which the price data are drawn, measurement error is a more significant source of valuation error than movement error for asset portfolios of reasonable size.

VI. Conclusions, Limitations, and Suggestions for Future Research

In general, the empirical results of this study suggest that the analytical model specified in Lim and Sunder (1987b) provides an accurate description of the properties of valuation rules, using the PPI, for U.S. industrial machinery and equipment for the time period of 1973–1980. The sole exception appears to be that the Lim and Sunder (1987b) model assumes zero Bias measurement error whereas this study's results support a finding of nonzero Bias measurement error. This single exception has significance for inferences about Bias and the effects of increasing index system fineness on MSE measurement error.

The specific findings may be summarized as follows:

1. Movement error Bias appears to be zero, but measurement error Bias when using BLS indexes may be significant.
2. Total MSE can be partitioned into MSE movement error and MSE measurement error.
3. Both MSE movement error and MSE measurement error appear to decline with the use of increasingly fine index systems, although the reduction in error is small.
4. Both MSE movement error and MSE measurement error appear to be reduced by asset portfolio diversification.
5. Both MSE movement error and MSE measurement error appear to be increased by lengthening the asset holding period.
6. MSE measurement error appears to be more significant than MSE movement error for most combinations of number of indexes used, various portfolio sizes, and asset holding periods.

Several implications from these results are apparent. First, in the economic environment examined, measurement error appears to be the major source of valuation error. Therefore, additional refinements in adjusting for pricing errors, substitution Bias, and technological or quality change error in price index construction seem necessary to improve valuation accuracy. Second, asset portfolio diversification appears to reduce both movement and measurement error. Hence, price indexes seem to be more accurate when applied to larger groups of assets rather than to very specialized strata of assets. Third, longer asset holding periods appear to increase both movement and measurement error. This result implies that the use of price indexes might be limited to assets of certain ages to increase valuation accuracy.

These results and implications are limited to the source of the price data, the PPI we examined, standard specifications of industrial machinery and equipment, and the time periods investigated. Findings are also dependent on assumptions that the Land prices are void of significant error and that BLS indexes contain significant error. Future research might use other time periods, assets, and price data to verify these findings.

In addition, the statistical theory of valuation does not provide a direct link from the empirical results of this article to the substantive producing, operating, and financing decisions of economic actors. Hence, there is no basis for making inferences about these activities. For instance, the theory does not explain how the econometric properties of asset valuation rules may affect the welfare of economic actors making choices conditional on this information. Thus, future research might examine the economic incentives and corporate preferences for the supplementary disclosure of current cost data containing error.

Furthermore, future studies might investigate the econometric implications of a significant asset valuation error on capital market research. For example, total error, and its components, may reduce the explanatory power of both the incremental information content methodology and the income measurement methodology of capital market research. Therefore, additional research is encouraged about the effects of total error and its components on the model construction and variables specification aspects of this aggregate research regarding economic actors.

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Assessing the Performance of Analytical Procedures: A Best Case Scenario

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SYNOPSIS: This study extends the existing research on the audit effectiveness of analytical procedures in a setting that used actual accounting data seeded with "material" simulated accounting errors. Five sample companies, whose revenues represented a wide range of time-series behavior, were selected to analyze the effects of eight commonly encountered accounting errors on 15 often-used analytical procedures (eight ratios and seven accounts).

A "best case" scenario was induced by using, among other factors, single-industry companies, quarterly data, and more sophisticated expectation models than had been used in prior studies. The best predicting of six candidate models (four naive, a regression, and the Census X-11 time-series model) was used to generate quarterly predictions for comparison with actual data seeded with the largest of four empirically based materiality measures. Five investigation rules, including two simple percentage change rules and a statistical rule using three different alpha levels, were applied to prediction errors to determine whether error investigations were correctly signaled.

The results of prediction model selection were dominated by X-11, followed by regression. Also, X-11 emerged as the "best" model more often for ratios than for accounts, while the reverse was true for the regression models.

Overall, the analytical procedures examined did not signal (Type I and Type II error rates) very well when applied in isolation to quarterly data.

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However, when the quarterly signaling results were "annualized," and when an annual material error was seeded into an individual quarter's data, the results were much more encouraging. The lowest error rates were observed for instances where the primary substantive test would have been direct recomputation (i.e., interest and depreciation errors). The assertion of SAS No. 56 that income statement accounts should be more predictable than balance sheet accounts was contradicted, but the evidence is limited.

The seeded quarterly material errors were generally swamped by prediction errors of the best-predicting expectation models. A significant correlation was observed between the ratio (prediction error/materiality) and the incidence of Type II signaling errors, indicating that this relationship might be used as a filter to determine when analytical procedures are likely to be effective audit tests.

Key Words: *Auditing, Analytical Procedure, Effectiveness.*

Data Availability: *Data used in this study will be made available upon request to the authors.*

THE combination of downward pressure on audit fees and demands that auditors take more responsibility for detecting misstatements in their clients' financial information has led auditors to seek audit procedures that are both efficient and effective. Both academic researchers (e.g., Arnett and Danos 1979; Eichenseher and Shields 1983; Cushing and Loebbecke 1986; Danos and Eichenseher 1986; Kinney 1988) and the business press (e.g., Baldwin 1987; Stevens 1988; *The Wall Street Journal* 1985, 1987) document what appears to be increasing competition among public accounting firms. Demands for more effective audits have come from several sources, including the public accounting profession (AICPA 1988a), the U.S. Congress (Dingell 1986), and the National Commission on Fraudulent Financial Reporting (Treadway Commission 1987, 52–53).

In recent years, CPAs have increased their use of analytical procedures in an effort to improve audit efficiency and effectiveness (see, e.g., Tabor and Willis 1985; Elliott 1983; Grobstein and Craig 1984; Stringer 1975). Furthermore, the Treadway Commission recommended that the Auditing Standards Board require the use of analytical procedures on all audits to improve the detection of fraudulent financial reporting. Shortly thereafter, the Auditing Standards Board adopted the Treadway Commission's recommendation by releasing SAS No. 56 (AICPA 1988b).

SAS No. 56 provides detailed guidance on using analytical procedures as substantive tests and requires their use during both the planning and final review stages of all audits. Regardless of the stage of the audit, analytical procedures involve a comparison of recorded amounts, or of ratios developed from recorded amounts, against expectations developed by the auditor (AICPA 1988b, par. 5).

Prior research comparing auditors' analytical procedure judgments to modeling techniques has shown that auditors: (1) are proficient at recognizing predictor variables in regression (Akresh and Wallace 1980); (2) may recognize and extrapolate (in a biased fashion) time-series patterns (Biggs and Wild 1985); (3) tend to use heuristics in interpreting analytical procedure information (Kinney and Uecker 1982; Libby 1985); and (4) do not use probabilistic (e.g., Bayesian) reasoning, but do exhibit "the kinds of reasoning processes being proposed and analyzed in artificial intelligence" (Biggs et al. 1988, 148).

Research addressing the effectiveness of analytical procedures has followed three general approaches: (1) *ex post* analyses of errors discovered in actual audits; (2) application of analytical procedures to simulated accounting data seeded with simulated errors; and (3) application of analytical procedures to actual accounting data seeded with simulated errors. The conclusions reached by these approaches are somewhat disparate. For example, studies using the *ex post* approach (e.g., Hylas and Ashton 1982; Kreutzfeldt and Wallace 1986) indicate that a large number of adjustments has resulted from the use of analytical procedures and recommend increasing their utilization. Studies using simulations (Knechel 1986, 1988a, 1988b) conclude that, subject to controlling the level of measurement error in the data, analytical procedures combined with detail tests can increase audit effectiveness beyond reliance on detail tests alone. In contrast, results of studies using actual data with seeded errors (Kinney 1987; Loebbecke and Steinbart 1987) conclude that the analytical procedures tested were *not*, in general, effective in discovering seeded material errors.

A possible explanation for these mixed results may be the empirical limitations of the work. For example, Kinney's study analyzed monthly data for one sample company. Since monthly data normally are not subjected to as much scrutiny as annual or quarterly data, measurement errors may have contributed to the poor error signaling by the ratios. Also, the results may have been sample specific. Loebbecke and Steinbart used annual audited data for multiple firms and restricted their analysis to frequently used naive expectation models. However, the application of analytical procedures to aggregated segments might have obscured predictable patterns in their data due to the use of companies that operate in multiple industries.

In addition, generalization of the obtained findings requires knowledge of the representativeness of the conditions studied. Unfortunately, the available data base is not adequate to evaluate the frequency of encountering a given set of conditions. Accordingly, in this paper we test analytical procedures under "best case" conditions using actual accounting data. If these circumstances lead analytical procedures to provide good error signaling, then a bridge could be constructed to consider the interaction between their effectiveness and their characteristics.

This study extends the works of Kinney (1987) and Loebbecke and Steinbart (1987) by evaluating the extent to which analytical procedures currently used by (or potentially useful to) auditors provide correct signals as to the existence of material misstatements under "best case" circumstances. The incidence of Type I and Type II errors was used to evaluate the correctness of the signals. A "best case" scenario was operationalized by using, among other factors, single-industry companies, quarterly accounting data, and more sophisticated expectation models than had been used in prior studies. The following section presents the research method employed, and the subsequent section details the results. The final section presents concluding comments and limitations.

I. Research Method

As did Kinney and Loebbecke and Steinbart, we seed actual accounting data with simulated errors. We combine advantages of each of these studies with additional conditions that we expect to improve the signaling abilities of analytical procedures. The primary "best case" conditions imposed are:

1. *Data requirements*: Quarterly data and five "single-industry" companies with differing time-series patterns for their revenues.
2. *Expectation models*: A more complex regression and the Census X-11 time-series model.
3. *Materiality definitions for error seedings*: Four were computed (as described below), with the largest being used for error seedings.

All other design features (e.g., investigation rules or accounts/ratios used) were structured to parallel prior studies. The remainder of this section describes our operationalization of the analytical procedure process including the "best case" conditions.

Data Requirements

Quarterly Data. The selection of data introduces a tradeoff between reliability and model sophistication. Kinney and Salamon (1979, 63) show that "measurement error in the independent variable does lead to an increase in the type I and type II errors" and that "the errors are increased as the measurement error increases." In this study, we use quarterly data to potentially provide more reliability because quarterly SEC filings and reviews by independent auditors are expected to induce greater concern for accuracy in a company's quarterly data than in its monthly data.[1] Although using annual audited data might enhance reliability, time-series requirements of the employed expectation models rule out the use of annual data. For this analysis, we used 36 consecutive quarters of data available on the COMPUSTAT data base.

Single-Industry Companies. To construct a "best case" scenario, we considered it important to avoid conglomerate companies in order to simulate the unit of analysis used by auditors when conducting analytical procedures. Silhan (1982) identified 60 public companies that essentially operated in one industry. Using his sample, we eliminated companies that were not on Quarterly COMPUSTAT or were in industries other than manufacturing, retail, or wholesale, and obtained 29 candidate companies.[2]

We examined the time-series behavior of the revenues of each of the 29 companies to identify differing combinations of commonly encountered time-series properties (i.e., trend, cycle, and seasonality). The Census X-11 time-series model (Cleveland and Tiao 1976; Dugan et al. 1985) and graphical presentation were used to identify the contributions of these time-series components. Five sample companies were selected, representing a cross-section of differing time-series behaviors encountered by practicing auditors. Figure 1 graphically depicts the time-series behavior of each company's sales

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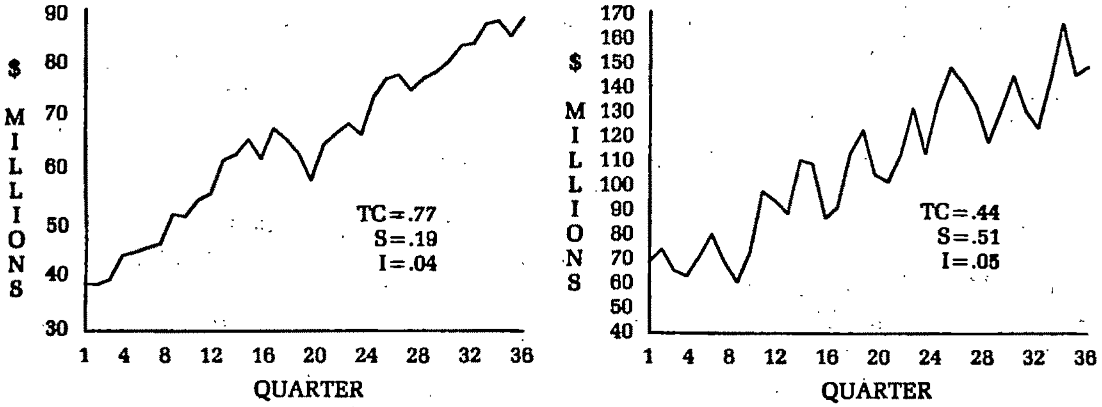
[1] Auditors' quarterly reviews may be performed retroactively at year-end. However, even when the reports are not reviewed quarterly, the report filing process itself, and the knowledge that a retroactive review will be performed are presumed to induce greater accuracy than would be found in monthly data. Representatives of four of the five sample companies told us that quarterly reviews were done by their auditors concurrent with each quarter, while Betz's representative informed us that their auditors performed retroactive quarterly reviews.

[2] Companies were restricted to the given industry categories for two reasons. First, research concerning the most commonly used analytical procedures (Coakley 1982; Holder 1983; Daroca and Holder 1985) generally has related to the prototypical manufacturing, wholesale, or retail company and a match between procedures and company types was needed for a "best case" scenario. Second, research concerning the most commonly encountered errors (Johnson et al. 1981; Hylas and Ashton 1982; Ham et al. 1985; Coakley and Loebbecke 1985) has also dealt with accounts and causes typical of these companies (e.g., errors in inventory, receivables, and payables).

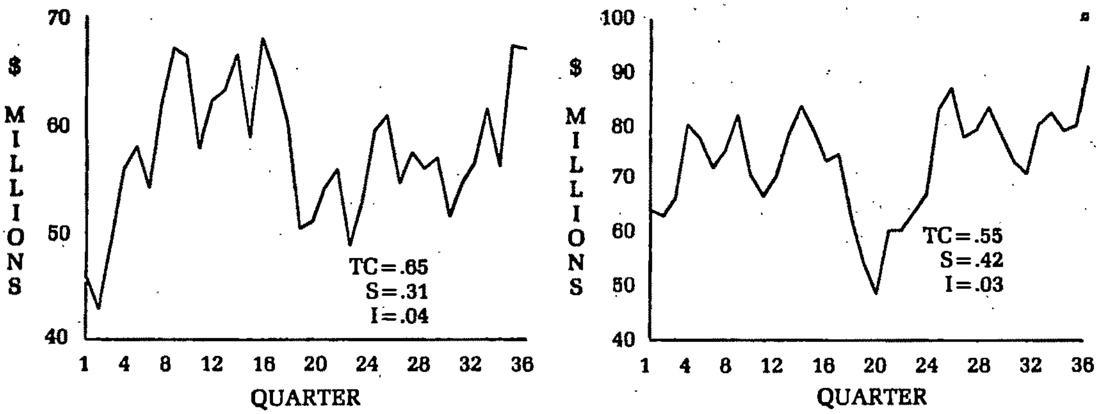
Figure 1

Graphs of Sample Companies' Sales for the 36 Quarters Ended March 31, 1987 and the X-11 Percentage Contributions of Time-Series Components (TC=Trend-Cycle, S=Seasonality, I=Irregular)



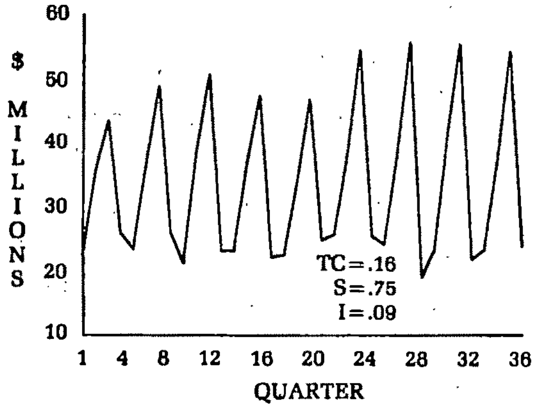
Betz Laboratories, Inc. (Trend)

Cooper Tire & Rubber (Trend+Seasonality)



A. M. Castle & Co. (Trend+Cycle+Seasonality)

Burndy Corp. (Cycle+Seasonality)



Swank, Inc. (Seasonality)

for the 36 quarters ended 31 March 1987, and provides the percentage contribution of each time-series component and a general description of each company's sales behavior.

Expectation Models

Candidate expectation models were selected to emulate current practice (i.e., the Martingale and Submartingale models) and to incorporate the suggestions from prior research for improving predictive abilities. The regression models were constructed to incorporate industry (Lev 1980) and contemporaneous firm-specific variables (Stringer 1975; Kinney 1978; Neter 1980; Loebbecke and Steinbart 1987) to accompany lagged versions of the dependent variable.

Given prior arguments against using ARIMA models in analytical procedures (Arrington et al. 1983), ARIMA models were replaced by the X-11 time-series model. The X-11 time-series model offers the potential to apply the sophistication of ARIMA in a much more user-friendly package (see Dugan et al. 1985).[3] A list of the candidate expectation models follows:

1. Martingale 1: $E(Y_t)=Y_{t-1}$.
2. Martingale 2: $E(Y_t)=Y_{t-4}$.
3. Submartingale 1: $E(Y_t)=Y_{t-1}+(Y_{t-1}-Y_{t-2})$.
4. Submartingale 2: $E(Y_t)=Y_{t-4}+(Y_{t-4}-Y_{t-8})$.
5. Regression: $E(Y_t)=\alpha+\beta_1(Y_{t-1})+\beta_2(Y_{t-4})+\beta_3(Y^i_{t-1})+\beta_4(Y^i_{t-4})+\beta_5(Z_t)$,

   where:

   Y_t = the observed level of account (or ratio) Y in quarter t,
   Y^i_t = the observed level of the industry average of account (or ratio) Y in quarter t, and
   Z_t = a contemporaneous firm-specific balance.

6. X-11: $E(Y_t)=T\times S\times I$,

   where:

   T is the trend-cycle component,
   S is the seasonal component, and
   I is the irregular component.

The contemporaneous firm-specific variables (Z_t) were chosen from the set of all other variables captured from COMPUSTAT. Regressions were run for each candidate Z_t term, and we selected the one with the smallest standard error of prediction during the model-building period.[4] Table 1 presents these variables by company, prediction

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[3] Like ARIMA, X-11 decomposes time-series data into its trend-cycle, seasonality, and irregular components. Once these components are identified ex *post*, X-11 also offers a program to generate forecasts (the YRAHEADOUT option). In predicting the trend-cycle component, the YRAHEADOUT program utilizes a univariate regression with time as the independent variable and the historical X-11 trend-cycle component as the dependent variable to generate four-quarter ahead forecasts. As constructed, this procedure does well at identifying and predicting the trend component, but it fails to extrapolate any cycle that may be present in the historical data. Therefore, in this study, X-11 was modified using an approach suggested by Makridakis et al. (1978, 392), which essentially fits several sine waves (or cosine, depending on whether the series starts in an upward or downward direction) to any cycle in the data.

[4] Loebbecke and Steinbart (1987) selected their contemporaneous variables based on the highest correlation between the dependent variables and the contemporaneous variables. However, the highest-correlated

Table 1
Contemporaneous Firm-Specific Balances (Z_t) for the Regression Models in the Four Quarter Prediction Periods Ending March 31, 1987/March 31, 1986[1]

	Sample Company				
	Betz	*Cooper*	*Castle*	*Burndy*	*Swank*
Account					
GSA	SAL/SAL	SAL/AP	SAL/SAL	CGS/SAL	SAL/SAL
SAL	CGS/GSA	CGS/CGS	CGS/CGS	CGS/CGS	CGS/GSA
CGS	SAL/SAL	SAL/SAL	SAL/SAL	SAL/SAL	SAL/SAL
AR	SAL/SAL	SAL/SAL	SAL/SAL	AP/AP	SAL/SAL
INV	AP/AP	AR/AR	AP/AP	AP/AP	SAL/AP
PPE	DEP/DEP	CGS/CGS	LTD/LTD	CGS/CGS	LTD/SAL
AP	TA/TA	TA/TA	CA/CA	INV/INV	INV/INV
Ratio					
ITN	SAL/AP	OPR/OPR	SAL/SAL	ART/ART	SAL/SAL
CSR	GSA/GSA	GSA/GSA	OPR/OPR	INV/INV	AR/AR
ART	AP/CGS	CSR/AP	TA/CGS	TA/TA	AP/AP
ACR	ITN/ITN	ITN/ITN	INV/INV	ART/ART	SAL/SAL
CRR	TA/TA	TA/TA	AP/AP	AP/AP	TA/TA
OPR	CSR/CSR	CGS/CGS	CSR/CSR	PPE/CGS	CGS/CGS
FAR	DEP/LTD	SAL/SAL	SAL/LTD	SAL/SAL	LTD/DEP
INR	—[2]	PPE/PPE	CSR/CSR	PPE/CSR	PPE/PPE

[1] Items in the table represent the firm-specific contemporaneous variables used in the regression models for the two four-quarter prediction periods. For example, for Betz's ITN ratio, SAL emerged as the Z_t term for the four-quarter prediction period ended March 31, 1987, while AP was used as the Z_t term for the four-quarter prediction period ended March 31, 1986.

[2] Betz did not have any substantial interest expense or long-term debt during the years examined.

Legend of Abbreviations

Accounts

GSA = General, Selling, and Administrative Expenses
SAL = Sales
CGS = Cost of Sales
AR = Accounts Receivable
INV = Inventories
PPE = Property, Plant, and Equipment
AP = Accounts Payable
TA = Total Assets
CA = Current Assets
DEP = Depreciation Expense
LTD = Long-Term Debt

Ratios

ITN = Inventory Turnover = CGS/INV
CSR = Cost of Sales Ratio = CGS/SAL
ART = Receivables Turnover = SAL/AR
ACR = Accruals Ratio = AR/AP
CRR = Current Ratio = CA/Current Liabilities
OPR = Operating Expense Ratio = GSA/SAL
FAR = Fixed Asset Ratio = PPE/TA
INR = Interest to Debt Ratio = Interest Expense/(LTD + Debt in Current Liabilities)

period, and account/ratio. Industry averages were constructed using all other firms in the same three-digit SIC code. As was done in prior studies (Arrington et al. 1982; Loebbecke and Steinbart 1987), we selected the best-predicting models using a criterion of minimizing the mean absolute error (MAE) of prediction models during the model-building periods. Only the best expectation models were then used to evaluate the error-signaling abilities of analytical procedures.

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contemporaneous variable may not always produce the best-predicting regression due to the possibility of omitted variables that may explain changes in both accounts.

Investigation Rules

To define an unusual change for further investigation, we used simple five-percent and ten-percent change rules, and a modified version of Kinney's (1987) statistical rule, with three separate alpha levels (0.05, 0.20, and 0.33).[5] The five-percent and ten-percent change rules signaled an investigation for differences (actual − expected) exceeding these percentages of the expected values.

In Kinney (1987), the statistical rule signaled an investigation if a given ratio was significantly different from its expectation, using an assumed normal distribution. Prediction errors were standardized as follows: $(r-\hat{r})/s_r$ (where r = value of the ratio; $\hat{r}$ = predicted ratio value; and s_r = standard deviation of the given ratio during the prior two years of monthly data). Since the auditor is interested in isolating those instances where actual balances are different from their predictions by an "unusual" amount, the standard deviation of the prediction errors (i.e., $s_{r-\hat{r}}$), would appear to be a better metric for defining "unusual." Therefore, we modified Kinney's rule and used the standard deviation of the prediction errors during the model-building period (i.e., the standard deviation of MAE) as the Z-score denominator. These prediction errors were first tested for the assumed normality using the Kolmogorov-Smirnov goodness-of-fit procedure.[6]

Three levels of alpha (0.05, 0.20, 0.33) were used to define the rejection region. Although the 0.33 level seems quite large when compared to conventional notions, Kinney (1987, 65) explained its use as "necessary to reduce Type II error risk [since in] analytical review, sample size cannot be increased."

Materiality Definitions for Error Seedings

Elliott's (1983) "audit gauge" [1.6 (greater of total assets or revenues)$^{2/3}$], and three additional materiality definitions were considered. We used ten percent of net income for our second measure (Holstrum and Messier 1982). As our third materiality definition, we followed Kinney's (1979) approach of ten percent of average earnings over a three-year period. Our fourth definition, 0.5-percent of revenues, is based on the findings of Warren and Elliott (1986). The four materiality measures were computed for each firm and we used the largest to provide the analytical procedures with the "best" chance of detecting errors.[7]

Accounting Error Types

We included the types of errors used in prior research as well as those commonly encountered by manufacturing and retail companies. The errors are:

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[5] The use of a statistical investigation rule in cases where a "naive" expectation model emerges best-predicting may not be an appropriate match. However, only a minor portion of the cases had naive models emerge best-predicting.

[6] Significant non-normalities ($p<0.05$) in the prediction errors were encountered for 14 of the 148 firm × analytical procedure × model-building period combinations. For all 14 instances, approximate normality was achieved by eliminating at most two outlier prediction errors (more than three standard deviations different from mean prediction errors) during the model-building periods. After removing outliers, the standard deviation was recomputed for applying the statistical investigation rule.

[7] Since audit gauge is based on the greater of total assets or revenues applied to annual numbers, and since quarterly total assets are usually much greater than quarterly revenues, this measure is not comparable to the other three materiality definitions when using quarterly data. To make the measures comparable, each quarter's total assets were first divided by four before comparison with quarterly total revenues when computing audit gauge.

1. Fictitious credit sale (or sales cutoff error).
2. Unrecorded credit purchase (inventory count correct).
3. Inventory cutoff problem misstating both inventory and purchases.
4. Interest expense miscalculation.
5. Unrecorded liability for general and administrative expenses.
6. Depreciation expense miscalculation.

The first two types of errors were used by Kinney (1987), while the remainder are based on those used by Coakley and Loebbecke (1985).[8]

Accounts and Ratios Analyzed

The following accounts and ratios were used:

Accounts

1. Inventory (INV)
2. Accounts Receivable (AR)
3. Accounts Payable (AP)
4. Cost of Sales (CGS)
5. Fixed Assets (PPE)
6. Sales (SAL)
7. General & Administrative Expenses (GSA)

Ratios

1. Inventory Turnover (ITN) = Cost of Sales/Inventory.
2. Cost of Sales Ratio (CSR) = Cost of Sales/Sales.
3. Accruals Ratio (ACR) = Accounts Receivable/Accounts Payable.
4. Receivables Turnover (ART) = Sales/Accounts Receivable.
5. Current Ratio (CRR) = Current Assets/Current Liabilities.
6. (INR) = Interest Expense/(Long-Term Debt + Debt in Current Liabilities).
7. (OPR) = Operating Expenses/Sales.
8. (FAR) = Fixed Assets/Total Assets.

Prior survey studies (Holder 1983; Daroca and Holder 1985) were used for selecting the ratios appropriate for the error types used. Using this list we were able to test (on a limited basis) an assertion made in SAS No. 56 that relationships involving income statement accounts tend to be more predictable than those involving balance sheet accounts (AICPA 1988, par. 14).

Dependent Measures

The dependent measures used to evaluate analytical procedure performance were the observed Type I error rates (signals to investigate without an error seeded) and Type II error rates (failure to signal with an error seeded) for each analytical procedure. Also, the sum of the observed Type I and Type II error rates was computed to assess the tradeoffs between types of errors. Loebbecke and Steinbart (1987) compared the Type I and Type II sum to a benchmark of 1.0, considering sums greater than or equal to this figure to be no more effective than a coin flip in deciding whether to investigate a given account. Adding the Type I and Type II rates implicitly assumes that the auditor is equally averse to either type of error (Knechel 1986). Since auditor risk preferences for the Type I and Type II errors would vary between auditors and situations, we have reported Type I and Type II rates independently. None of the combined rates attempt to apply differential weights.

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[8] In certain cases we summarized several of Coakley and Loebbecke's (1985) entries (e.g., several entries relating to accruals are summarized in our fifth error type). Also, data limitations associated with Quarterly COMPUSTAT made it impossible to use bad debt expense and the allowance for doubtful accounts.

Also, summing the Type I and Type II rates creates the possibility of double counting of errors. For instance, consider an instance where a Type I error exists. Seeding a material error into the actual balance might bring it closer to the prediction by an amount sufficient to generate a Type II error as well. Since an account is either in error or not in error, the generation of two errors for a single prediction is not realistic. Therefore, Type I and Type II error rates are presented independently. When summing the Type I and Type II error rates, the double counts are removed. It should be noted that after removing the double counts, the Type I and Type II sum cannot be greater than 1.0 and, hence, comparisons to the Loebbecke and Steinbart (1987) benchmark are not meaningful.

II. Results

The research approach produced over two thousand different comparisons (two error seed conditions × five companies × eight quarters × five investigation rules × varying number of accounts/ratios affected by each seeded error). The discussion of results is divided into four sections as follows: (1) the best-predicting model results; (2) the Type II error rates when "material errors" were seeded, and the combined Type I and Type II error rates for each account/ratio; (3) an "annualized" analysis of the error signals; and (4) an analysis of potential causes of observed analytical procedure performance.

Best-Predicting Model Results

Using the mean absolute prediction errors (MAE) during the model-building periods, three observations can be made. First, the X-11 and regression models together dominated the results.[9] Neither of the Submartingale models nor the four-quarter lag Martingale model emerged as best-predicting in any instance. Second, for 99 of 148 (67 percent) of the instances, X-11 yielded the lowest MAE of the six candidate expectation models. This result is not totally surprising because four of the sample companies include cyclical and/or seasonal time-series patterns that are most completely modeled by X-11. Somewhat counterbalancing this X-11 advantage is the inclusion of industry data in the regressions. Third, while X-11 emerged best in a majority of instances for both accounts and ratios, its success proportion was much higher for ratios (0.80) than for accounts (0.53), which is significantly different (at $p < 0.01$) using a binomial test. Conversely, the proportion of instances where regression emerged best-predicting was significantly higher (at $p<0.01$) for accounts (0.44) than for ratios (0.18).

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[9] We compared the relative performance of the X-11 model and the regression models by constructing the ratios of each model's respective MAE in all firm × period × account/ratio combinations. To provide a common scale for comparison, the model with the lower MAE was used for the numerator of the constructed ratios. The mean ratio of respective MAE's when X-11 predicted better was 0.70 (a range of 0.23–0.99) compared to 0.72 (a range of 0.37–0.98) when regression predicted better. Means were not significantly different ($t = 0.48$, $p > 0.80$).

Type II and Type I Errors

Error Seedings. Material errors were first seeded in the accounts and ratios in accordance with the patterns summarized in the Appendix to this paper. The largest of "audit gauge," ten percent of income, ten percent of average income, and 0.5 percent of revenues was used for error seedings in the eight prediction quarters for each ratio and account.

Results. The five investigation rules were applied to the prediction errors (actual with seeded error minus the prediction) to determine the instances where no investigation was signaled (i.e., a Type II error). Dividing by eight yielded the Type II error percentages. Type I error rates were similarly generated from the instances where an investigation was signaled when no "material error" was seeded. As mentioned previously, when combining the Type I error rates with the Type II error rates an adjustment was made for instances where both a Type II and Type I error were signaled in the same quarter. Table 2 presents selected summary results and a preliminary screening of the five investigation rules across all error types and sample companies.

Examining the results by investigation rule, the lower error rates for the statistical rules are consistent with Kinney (1987). However, in order to avoid Type II error rates which would be "practically unacceptable," it appears that the 0.33 alpha statistical rule would be preferred over others, despite its slightly higher combined Type II and Type I error rate. All subsequent discussion of results will generally be restricted to the 0.33 alpha statistical rule.

Consistent with Kinney (1987) and Loebbecke and Steinbart (1987), the quarterly signaling results, taken in isolation, are not encouraging for these analytical procedures. For instance, as summarized in table 2, about 61 percent of the 1005 rule combinations had unadjusted combined Type II and Type I error rates of 1.00 or higher. In only five instances was the sum of Type II and Type I error rates equal to zero. Three of these five zero-sum instances occurred in the interest expense miscalculation error, and all five involved the use of the 0.05 alpha statistical investigation rule. Further, average Type II error rates using the best investigation rule were in the 0.25–0.30 range. Error rates of these magnitudes would normally be considered high for substantive audit tests. If analytical procedures are combined with other audit tests, these error rates might be deemed acceptable to practicing auditors, given the efficiency of analytical procedures. However, this issue is beyond the scope of this study.

Data and Model Comparisons. Comparisons of the average error rates between accounts and ratios are shown in table 2. The average adjusted combined Type II and Type I error rate for ratios (0.823) was significantly lower (at $p<0.05$, one tail) than the average combined rate for accounts (0.868). Comparing the Type II rates alone showed that the average for ratios (0.302) was significantly higher (at $p<0.05$) than the average for accounts (0.263). Combining these results, the ratio group had significantly lower Type I error rates than the account group. These differential error rates are somewhat overlapping, however. That is, independent of the seeding of errors, accounts tended to produce more investigation signals (i.e., higher Type I error rates) than ratios. Even after errors were seeded, the differences in signaling tendencies would remain. Therefore, part of the better average Type II error rates for accounts may have been caused

Table 2
Summary Results for Type II and Type I Errors[h]

Number of combined Type II and Type I error rates equal to or exceeding 1.00 (before adjusting for double counts)[i]	614 (61%)
Number of combined Type II and Type I error rates equal to 0[a]	5 (1%)

Investigation Rule	*Average Type I*	*Average Type II*	*Sum*	*Adjusted Sum*[i]
Statistical (0.05)	0.116	0.745	0.861	0.835
Statistical (0.20)	0.427	0.487	0.914	0.861
Statistical (0.33)	0.637	0.285	0.922	0.845
Naive (5%)	0.322	0.611	0.931	0.889
Naive (10%)	0.190	0.812	1.002	0.985

	Using 0.33 Alpha Rule	
Analytical Procedure Group	*Average Type II Error Rates*	*Average Combined Types II & I Error Rates*[i]
All Ratios	0.302[b]	0.823[c]
All Accounts	0.263[b]	0.868[c]
Balance Sheet Accounts Only	0.256[d]	0.850[e]
Income Statement Accounts Only	0.264[d]	0.888[e]
X-11 best-predicting	0.288[f]	0.835[g]
Regression best-predicting	0.281[f]	0.857[g]

[a] Three of these five instances are from the interest miscalculation as detected by the INR ratio while the remaining two come from the depreciation miscalculations through analysis of the PPE account. All involve the statistical investigation rule with a 0.05 alpha.

[b] Mean for ratios significantly larger ($t=2.10$, $p<0.015$).

[c] Mean for ratios significantly smaller ($t=1.66$, $p<0.05$).

[d] Means not significantly different ($t=0.40$, $p>0.70$).

[e] Means not significantly different ($t=1.41$, $p>0.15$).

[f] Means not significantly different ($t=0.35$, $p>0.72$).

[g] Means not significantly different ($t=1.10$, $p>0.26$).

[h] In the interest of parsimony, detail error rates by sample companies and error types are not presented.

[i] "Double counting" of errors occurred in situations where a Type I error was present and the seeding of a material error brought the balance closer to the prediction, far enough to cause a Type II error, as well. Thus, Type I and Type II rates are presented independently, but the combined rates count the error only once.

by the carryover of worse Type I rates. The differential impact of errors on ratios and accounts was also observed by Kinney (1987, 62).

A possible explanation for the observed differential performance by analytical procedures on accounts and ratios may concern the effect of ratio construction on time-series behavior. For instance, consider the cost of sales ratio. Due to the presence of fixed costs in the cost of sales, this account should exhibit slightly less volatility than sales. With the cancellation of mutual variability through ratio construction, the extra volatility of the sales account will largely comprise the variability of the cost of sales ratio. Accordingly, this ratio may become easier to predict, especially by a model able to capture nontrend components. This premise shows in the results. While the regression model predicted sales and cost of sales best substantially more often than X-11, the cost of sales ratio was predicted best in nine of ten instances by X-11.

The account group was partitioned to test SAS No. 56's assertion that income statement accounts are more predictable than balance sheet accounts. As seen in table 2, neither the average Type II error rates (0.256 for balance sheet, 0.264 for income statement) nor the combined Type II and Type I error rates (0.850 for balance sheet, 0.888 for income statement) were significantly different. Although this evidence is not conclusive, it is inconsistent with the contention of SAS No. 56.

We also compared Type II and the combined Type II and Type I error rates, depending upon whether X-11 or the regression model emerged as best-predicting. Table 2 shows that X-11's average Type II error rate was higher, and X-11's combined Type II and Type I error rate was smaller, although neither difference was significant.

Table 3 presents the Type II error rates by error type across the five sample companies using the 0.33 alpha statistical investigation rule. Again, the sums of the Type I and Type II errors are provided to assess the tradeoff between them.

The performance of one error type and ratio combination deserves individual discussion. Specifically, the ratio of interest expense to interest-bearing debt yielded only one Type II error in 32 sample company quarters examined (a 0.03 rate) using the 0.33 alpha statistical rule. In conjunction, the average Type I error rate over these quarters was 0.51. Using the more sensitive 0.05 alpha statistical rule, the Type II errors would have increased to only two (of 32), while the average Type I error rate would have been 0.09. No other error type/analytical procedure combination distinguished itself similarly across all sample companies.

Table 3 also reveals that the second-best analytical procedure performance is in the depreciation miscalculation error analysis. For both interest and depreciation, a typical detail substantive test is recomputation. Therefore, the evidence suggests that analytical procedure effectiveness is greatest in situations where the primary substantive procedure is recomputation.

"Annualized" Quarterly Signaling Results

The analysis to this point may be summarized as presenting the likelihood of Type II error detection when only one quarter of a year has been misstated by exactly a "quarterly" material amount. In an audit situation, both more and different sizes of errors may occur between quarters. Knechel (1986) points out the problem of defining Type II error rates when using interim data, and both Knechel (1986) and Kinney and Salamon (1979) have demonstrated that analytical procedures were less likely to detect smaller errors spread over a number of periods. Thus far, the Type II results are conservative from an "annualized" standpoint since, in practice, an investigation in one quarter may lead to further analysis and error detection in another quarter. Also, with quarterly material errors, an auditor would generally need to detect and adjust only one of the quarterly errors to render an account materially accurate on an "annualized" basis. If a material "annual" error is concentrated in one quarter, analytical procedure effectiveness may also be expected to improve.

Whether an error is concentrated in one quarter or spread over four quarters will vary by the nature of the error generation process. There is no clear way to assess whether an "annual" or "quarterly" material amount should be seeded. To address this

Table 3

Type II Error Rates and (Combined Type II and Type I Error Rates) (Across five sample companies using the 0.33 alpha investigation rule)[1]

AP Affected	*Fictitious* Sale	*Unrecorded* Purchase	*Inventory Cutoff (Overstated)*	*Inventory Cutoff (Understated)*	*Unrecorded General and Administrative* Expenses	*Depreciation Miscalculation (Understated)*[3]	*Depreciation Miscalculation (Overstated)*[3]	*Interest Miscalculation*[2]
Account								
GSA	—	—	—	—	0.175 (0.950)	0.175 (0.950)	0.200 (0.963)	—
SAL	0.425 (1.000)	—	—	—	—	—	—	—
CGS	—	0.325 (0.963)	0.325 (0.963)	0.250 (0.875)	—	—	—	—
AR	0.250 (0.938)	—	—	—	—	—	—	—
INV	—	—	0.275 (0.975)	0.200 (0.925)	—	—	—	—
PPE	—	—	—	—	—	0.275 (0.875)	0.300 (0.950)	—
AP	—	0.250 (0.825)	—	—	0.250 (0.825)	—	—	—
Ratio								
ITN	—	0.375 (0.950)	0.325 (0.925)	0.250 (0.813)	—	—	—	—
CSR	0.375 (0.925)	0.225 (0.763)	0.225 (0.763)	0.300 (0.863)	—	—	—	—
ART	0.250 (1.000)	—	—	—	—	—	—	—
ACR	0.475 (0.963)	0.250 (0.788)	—	—	0.250 (0.788)	—	—	—
CRR	0.325 (0.963)	0.275 (0.838)	—	—	0.275 (0.838)	—	—	0.150 (0.925)
OPR	0.400 (0.950)	—	—	—	0.200 (0.763)	0.200 (0.763)	0.100 (0.675)	—
FAR	0.350 (0.963)	—	0.350 (0.950)	0.375 (0.913)	—	0.350 (0.950)	0.350 (0.913)	—
INR	—	—	—	—	—	—	—	0.031 (0.513)

[1] Combined Type II and Type I rates have been adjusted to remove any "double counts"—see note i on table 2.

[2] Betz Corporation did not have any substantial interest expense or long-term debt in the years examined and, hence, the rates for this error include results for only four sample companies.

[3] For the companies used in this study, depreciation could affect both GSA and CGS. Since splitting the effect of the error between GSA and CGS would make the AP's perform worse and a "best case" scenario was desired, the entire depreciation error was seeded into GSA.

Table 4
Summary Signaling Results for Four "Annualized" Quarterly Investigation Rules and for "Annual" Material Errors Concentrated in Individual Fourth Quarters

	Type II Error Rates (Using 0.33 Alpha Rule)	
Analytical Procedure	*"Annualized" Quarterly Investigation Rules During 1986*[1]	*"Annual" Material Error Concentrated in Individual Fourth Quarters of 1986 and 1985*
Account		
GSA	0 , 0.05, 0.27, 0.65	0.07
SAL	0 , 0.60, 0.80, 1.00	0
CGS	0 , 0.40, 0.65, 1.00	0.03
AR	0 , 0 , 0.20, 0.80	0
INV	0.10, 0.20, 0.20, 0.80	0.05
PPE	0 , 0 , 0.40, 0.60	0.15
AP	0 , 0.20, 0.40, 0.80	0
Ratio		
ITN	0 , 0.33, 0.73, 0.83	0.17
CSR	0 , 0.25, 0.55, 0.80	0.07
ART	0 , 0.20, 0.60, 1.00	0
ACR	0.07, 0.33, 0.73, 0.80	0.27
CRR	0 , 0.20, 0.44, 0.80	0.21
OPR	0 , 0 , 0.25, 0.88	0.20
FAR	0 , 0.12, 0.60, 0.88	0.12
INR	0 , 0 , 0 , 0	0
Total Type II Error Rates for all APs	0.01, 0.25, 0.45, 0.78	0.08
Total Type I Error Rates for all APs	0.96, 0.79, 0.50, 0.13	0.72

[1] Figures represent the Type II error rates using "annualized" investigation rules which require (in order) at least one, two, three, or four quarterly investigation signals during calendar 1986 before annual balances would be investigated.

issue, we supplemented the analysis in two ways. First, we applied four possible "annualized" investigation rules to quarterly results from calendar 1986. Second, we seeded "annual" material errors into the fourth quarters of the two prediction years and assessed their signaling performance. Table 4 presents these results.

The four "annualized" rules require at least one, two, three, or four quarterly signals, respectively, before the year-end balance is investigated. The summary results show that a rule that investigates when at least one quarterly signal is generated yields only 0.01 Type II error rate across all analytical procedures. When no error was seeded, such a detection rule would lead to a 96 percent Type I error rate. In short, this rule almost always signals an investigation. These results are consistent with the argument that "analytical review may be good at spotting the presence of errors, but does not reliably indicate the absence of errors" (Loebbecke and Steinbart 1987, 87).

Under our second approach, an "annual" material error was seeded into fourth-quarter balances for the two prediction years to simulate material year-end cutoff errors. As seen in table 4, the Type II error rate across all analytical procedures tested was 0.08 with a corresponding Type I error rate of 0.72. Consistent with prior studies (Knechel 1986; Kinney and Salamon 1979), these results indicate that large, isolated errors are more likely to be detected using analytical procedures.

Analysis of Potential Causes of Observed Performance

Loebbecke and Steinbart's (1987) analysis provided evidence that analytical procedure signaling abilities may be tied to the relationship of prediction errors to the level of materiality (i.e., the errors "swamped" the materiality definitions). In order to investigate these potential "swamping" causes for accounts examined in this study, each company's average materiality levels for the two four-quarter prediction periods were compared to the average prediction errors during those periods. Like Loebbecke and Steinbart, the average prediction errors generally exceeded the average materiality measures (54 of 70 cases). As a test of the simple rules often used by auditors, we compared the average materiality measures to the average investigation thresholds of the ten-percent change investigation rule. Across all five companies, the ratio of these thresholds to the materiality measures ranged from 0.96 to 19.3 with a median of 8.0. Therefore, an auditor using a simple ten-percent change rule for these firms would require, on average, an error eight times larger than the computed materiality level before an investigation would be signaled.

We also computed the ratio of the quarterly prediction errors to materiality (PE/MAT) for each account across all sample companies to investigate if there was a relationship between this ratio and the incidence of Type I and Type II errors. As seen in table 5, the PE/MAT ratio was significantly correlated with the presence or absence of signaling errors, especially for Type II errors. Table 5 also shows the classification of Type II and Type I errors according to a PE/MAT level of 1.0 (i.e., when prediction errors do or do not exceed materiality). Given the significance of the classification table results, it appears that a threshold of 1.0 for PE/MAT provided a fairly accurate filter for determining when to place reliance on analytical procedures to detect seeded errors.

III. Concluding Comments

Discussion and Potential Contributions

This article suggests the need for developing expectation models that improve the efficiency and sufficiency of analytical procedures. The results reported here indicate that, when cast in a scenario facilitating effectiveness, the analytical procedures tested in this study generally did not perform well in signaling errors from the vantage point of an individual quarter. However, when the quarterly results were interpreted from an "annualized" perspective, and when "annual" material errors were seeded in year-end quarterly balances, the results are much more promising.

The results of this and prior studies indicate that analytical procedures may enhance audit effectiveness, especially when employed in conjunction with some mini-

Table 5
Relationship of Prediction Errors to Materiality (PE/MAT) and the Incidence of Type I and Type II Errors for Accounts

- Spearman Rank Correlation Coefficient Between (PE/MAT) and the Presence (1) or Absence (0) of a Type II Error[1] $-.74$ ($p<0.01$)
- Spearman Rank Correlation Coefficient Between (PE/MAT) and the Presence (1) or Absence (0) of a Type I Error[1] $.56$ ($p<0.01$)

Panel A. Classification of Type II Errors Using a PE/MAT level of 1.0:

		PE/MAT ≥1.0	PE/MAT <1.0	
Type II	Yes	34	116	150
	No	392	18	410
		426	134	560[2]

Chi-square with 1 df $=321$ ($p<0.01$)

Panel B. Classification of Type I Errors Using a PE/MAT level of 1.0:

		PE/MAT ≥1.0	PE/MAT <1.0	
Type I	Yes	337	81	418
	No	53	89	142
		390	170	560[2]

Chi-square with 1 df $=94$ ($p<0.01$)

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[1] Using the 0.33 alpha investigation rule.

[2] Total incidences for accounts are five sample companies × eight predicted quarters × two accounts per accounting error × seven accounting errors that affected accounts.

mum level of traditional substantive procedures. However, caution should be exercised in determining the degree of reliance to be placed on analytical procedures when used in isolation.

Another potential contribution of the study concerns the application of the Census X-11 time-series model to accounting data. In the data analyzed here, X-11 predicted better than any other expectation model used. While X-11's performance may be largely explained by the selection of sample companies exhibiting nontrend time-series behavior, these nontrend components are commonly encountered in accounting data and must be considered if data other than annual are used.

Limitations

While quarterly data were presumed more reliable than monthly data, results indicate that the noise level in the data analyzed (as evidenced by large prediction errors) may have seriously handicapped the simulated quarterly analytical procedures. Also, the manner in which industry indices were constructed for the regression models may have limited these models' effectiveness. Specifically, the sample companies were selected from Silhan's (1982) "single-industry" firms. Since few companies are in a single industry, the constructed industry indices were most likely based on conglomerate companies and may not have been strictly comparable to the sample companies. Also, the regression models were restricted to financial variables. If other, nonfinancial information (i.e., production data) had been available, the signaling accuracies of the regressions may have been different.

This study was limited to looking at analytical procedures in a strictly mechanical sense. Any additional company-specific information that might be obtained through inquiry by an experienced auditor could not be captured. Thus, the effectiveness of analytical procedures in locating errors may be underestimated by considering the results of this study independent of other information. Since it is likely that these procedures would be coupled with other detail tests or other analytical procedures, the noted error rates are not necessarily correspondent with achieved detection risk.

Appendix

Impact of Accounting Errors on Analytical Procedures

Analytical Procedure	*Fictitious Sale*	*Unrecorded Credit Purchase*	*Inventory Cutoff Error (Over/Under)*		*Interest Expense Miscalculation*	*Unrecorded G&A Expense*	*Depreciation Miscalculation (Under/Over)*	
Ratios								
Inventory Turnover	—	↓	↓	↑	—	—	—	—
COS Ratio	↓	↓	↓	↑	—	—	—	—
A/R Turnover	↓	—	—	—	—	—	—	—
Accruals Ratio	↑	↑	—	—	—	↑	—	—
Current Ratio	↑	↑	↑	↓	↑	↑	—	—
Operating Expense to Sales	↓	—	—	—	—	↓	↓	↑
Fixed Assets to T.A.	↓	—	↓	↑	—	—	↑	↓
Interest Expense to Debt	—	—	—	—	↓	—	—	—
Accounts								
Sales	↑	—	—	—	—	—	—	—
Inventory	—	—	↑	↓	—	—	—	—
Cost of Sales	—	↓	↓	↑	—	—	—	—
A/R	↑	—	—	—	—	—	—	—
A/P	—	↓	—	—	—	↓	—	—
Fixed Assets	—	—	—	—	—	—	↑	↓
G&A Expense	—	—	—	—	—	↓	↓	↑

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Accounting Procedures, Market Data, Cash-Flow Figures, and Insolvency Classification: The Case of the Insurance Industry

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SYNOPSIS: The property-liability (P&L) insurance industry has used statutory accounting principles (SAP) primarily for measuring and monitoring solvency. In recent years disputes have arisen concerning differences between SAP and the Generally Accepted Accounting Principles (GAAP), and their applications to the P&L industry. The distinguishing characteristics of SAP include the use of market prices for valuation of equity portfolios of P&L firms, and the mismatching of revenues and expenses. The present study compares SAP with GAAP and with an alternative accounting procedure that might be called market value- and cash-flow-based principles (MVA). The main characteristics of MVA are the use of market data for valuation of both stock and bond portfolios, and the use of cash flow for earnings.

The purpose of this study is to determine which of the three accounting procedures provides better information for monitoring solvency and identifying financial distress. Thus, the major hypothesis of this study is that increased availability of market-based data and increased reliance on cash-flow figures yield incremental benefits in predicting financial insolvency in the P&L industry.

Some empirical evidence with respect to the relative efficacy of SAP has been reported for the late 1960s and the 1970s. These earlier studies

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used multidiscriminant analysis (MDA) and suffered from some methodological problems. The present study extends previous analyses by using relatively more comprehensive accounting data in logit analysis.

A sample of 105 P&L companies that failed during the period 1975–1987 is used in this study. The insolvent insurers were matched with 106 P&L insurers selected at random from A. M. Best files. The solvent and insolvent samples were each split into an estimation sample and a holdout sample. The results of this study are reported for one and three years prior to insolvency. Univariate analysis and multivariate logit analyses are presented.

The hypothesis that alternative accounting procedures provide similar classification results was rejected in this paper for both the estimation and holdout samples and for the one and three years prior to the onset of insolvency. The analyses also considered misclassification costs, prior probabilities, and choice-based sample biases; both MVA and SAP procedures outperformed GAAP procedures for all classification and prediction (validation) comparisons. MVA slightly dominated SAP procedures for several comparisons of classification and prediction, but the differences were often not significant. Thus, empirical evidence presented suggests that the SAP and the MVA provide classification and prediction of insolvencies in the P&L insurance industry over and above that provided by the GAAP.

Key Words: *Alternative Accounting Procedures, Insolvency Classification, Market Data and Cash-Flow Figures, Property-Liability Insurance Industry.*

Data Availability: *The author of this paper is willing to make the data available for others. A hard copy of the data may be obtained by writing directly to the author.*

THE property-liability (P&L) insurance industry has made mandatory use of statutory accounting principles (SAP) for measuring and monitoring solvency.[1] The increased number of P&L insurer defaults since 1988 has focused considerable attention on the efficiency of solvency regulation. Furthermore, in recent years disputes have arisen within the AICPA, the FASB, and the National Association of Insurance Commissioners (NAIC) concerning differences between the SAP and Generally Accepted Accounting Principles (GAAP) and their applications to the P&L industry.[2] In its statement on Accounting and Reporting by Insurance Enterprises, the Financial Accounting Standards Board (FASB, SFAS No. 60 1982) recognizes the use of the basic principles of SAP for property-liability insurance enterprises. The present study seeks to determine whether SAP facilitates an earlier and/or more accurate identification of insolvency for P&L insurance companies than do alternative accounting practices such as GAAP or market-value- and cash-flow-based financial statements.

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[1] Solvency has been promoted by statutes as the primary objective that requires the development and enforcement of special measures such as SAP. The insurance industry is deemed to be a business vested with the public interest and is regulated by various states. Major issues in the regulation of the insurance industry are discussed in the Audit Guide (AICPA 1982, chap. 2).

[2] The NAIC has usually supported the use of SAP. Regulators impose higher standards of financial solidity on insurance enterprises than on other corporations. However, the Audit Guide (AICPA 1982, chap. 9) suggests the need to supplement SAP with schedules that reconcile it with GAAP.

The objective of this paper is to compare the usefulness of three different accounting procedures for the prediction of insolvency among P&L insurers. SAP data sets are compared with GAAP figures, and also with data from an accounting procedure that values assets at market value, and earnings at cash-flow streams (i.e., income numbers are measured at cash inflows and outflows). This latter procedure may be called Market Value Adjustments and Cash-Flow Earnings Figures (MVA).

Most insurance regulators argue that SAP provides measures for early identification of financial distress or conditions leading to insolvency. The SEC requires, however, that publicly traded P&L insurers also file GAAP financial statements with the SEC (SEC, Series Release No. 183).

As insurance is a financial industry, most assets of insurers are invested in stocks and bonds. Market data, and certain profit measures that incorporate stock and bond market data, should reflect both market expectations of the value and the going concern of these assets, whereas other measures (e.g., those based on accrual values as employed by GAAP) may be devoid of such expectations. Thus, the major hypothesis of this study is that increased availability of market-based data and increased reliance on cash-flow figures yield incremental benefits in predicting financial insolvency in the P&L industry. This hypothesis is especially relevant to the P&L industry because it is one of the few industries that issues financial statements using procedures other than GAAP. The data for SAP, GAAP, and MVA are available from a common data base. SAP data are reported on the balance sheet, income statement, notes, and schedules. Data useful for converting to GAAP and MVA are available from the schedules, appendices, and tables, but not in separate tables or schedules.

I. The Insurance Industry

A. M. Best reports that approximately $405 billion in total premiums were written by insurance companies in the U.S. in 1987. P&L insurers wrote approximately 47 percent of these premiums. Total assets of insurers exceeded $1,470 billion in 1987, of which about 63 percent was invested in stocks, bonds, and other securities. Total assets of P&L insurers were $427 billion in that year, of which 73 percent was invested in stocks and debt securities, generating investments income and gains of $24 billion.

Accounting Procedures

The insurance industry has used uniform accounting procedures since the 1870s. These statutory accounting principles (SAP) and the Annual Convention Statement (see Troxel and Breslin 1983) are promulgated by state insurance departments and the NAIC. The Annual Convention Statement of the P&L industry, for example, includes a balance sheet and income statement reported in accordance with SAP. Financial statements based on SAP focus on a company's solvency and its ability to meet contractual obligations and are thus of particular interest to policyholders. These principles, together with standardized Annual Convention Statements, have brought about uniform reporting by P&L insurers. Foster (1978, chap. 10) noted that using uniform accounting procedures (i.e., SAP) meant that a potentially important source of noise in many cross-sectional studies that use accounting data was substantially reduced.

The SAP procedure used by the P&L insurance industry differs in important respects from GAAP. These distinguishing characteristics of SAP include the use of market prices for valuation of equity portfolios of P&L firms, and the matching of revenues and expenses. Acquisition costs are debited as expenses when they are incurred and are not reported *pro rata* over the policy term, whereas premiums are credited as revenue over periods covered by the related policies. Prepaid acquisition expenses are therefore not recorded. Other major characteristics of SAP are the treatment of unrealized capital gains (losses) from investments in stocks; treatment of assets such as equipment and furniture as nonadmitted (see Appendix); and the use of market prices for valuation of stock portfolios, but amortized value for valuation of bond portfolios. For the purpose of SAP, earnings are defined to include underwriting earnings, net investment income, and realized and unrealized gains on investment in equity securities.[3]

Unrealized capital gains and acquisition costs have a substantial effect on earnings. During 1980, for example, SAP-derived underwriting loss for the P&L industry was $3.3 billion, net investment income was $11.1 billion, and realized capital gains were $0.5 billion. Unrealized capital gains (charged directly to surplus) were $4.3 billion. The GAAP underwriting loss would be $2.4 billion. Thus, the SAP earnings number substantially differed from GAAP-derived earnings. Foster (1977) investigated the role of different components of income on security prices of 22 publicly traded P&L insurers and demonstrated the use of economical and statistical criteria to determine the composition of net income most consistent with observed security prices. He concluded that the sum of underwriting and investment earnings and capital gains on equity securities (i.e., the SAP earnings) provided the best determination of the market values of publicly traded P&L insurers. (For these and other issues, also see Harmelink 1973; Foster 1975; Kross 1978; AICPA 1982; FASB 1982; Troxel and Breslin 1983.)

The MVA procedure is developed in this paper because it enables one to test whether market data and cash-flow-based earnings may lead to more accurate classification of solvent and insolvent insurers than do figures based on accrual data. The main characteristics of the MVA are the use of market data for valuation of both stock and bond portfolios, and the use of cash flow for earnings. The MVA numbers differ substantially from those of the SAP. For example, the cross-sectional correlation between SAP and MVA underwriting-based earnings for 30 publicly traded P&L insurers in 1987 was −0.407; whereas the cross-sectional correlation for net investment income figures was 0.985. Further explanations and a short numerical example are provided in the Appendix, which also contains details of actual data (SAP, GAAP, and MVA numbers) from two sample firms.

Incremental Results Compared with Prior Research

Harmelink (1973) adjusted the value of insurers' investments in stocks derived from SAP to conform with historical cost data. No significant differences were found in the ability of these two alternate data sets to predict the degree of solvency among insurers, as measured by a decline in Best's Policyholders' Rating (A. M. Best Company). Pinches and Trieschmann (1977) used financial ratios and multidiscriminant analysis (MDA) to classify 26 solvent and 26 insolvent insurers during the late 1960s and early 1970s. Ambrose and Seward (1988) used financial ratios and a system of dummy variables in MDA to classify 58 solvent and insolvent P&L insurers. These studies employ MDA alone, which has been criticized for being used in classifications of bankruptcy, takeover targets, and risk-rating literature (e.g., Kaplan and Urwitz 1979; Ohlson 1980; Zmijewski 1984; Zavgren 1985; Palepu 1986). The main argument against MDA is that it ignores the ordinal nature of the dependent variable. Moreover, it requires strong distributional assumptions about the variables, as well as the variance/covariance matrices, and it does not have convenient tests of significance. Prior probabilities, sample biases, misclassification costs, and other methodological flaws were not considered in prior studies on insurance company data (Harmelink 1973; Pinches and Trieschmann 1977; Ambrose and Seward 1988). The importance of these issues, however, has been considered in many studies. For example, Ketz (1978) concluded that general price level adjustments are useful for predictability when the relative costs of misclassification are considered. The present study uses larger samples, eliminates a number of the methodological deficiencies of prior studies, and examines accounting issues not discussed in most previous studies.

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[3] Other differences between SAP and GAAP are: (1) measurement of liability for future policy benefits; (2) treatment of dividends to policyholders; (3) interperiod tax allocation; and (4) consolidation of subsidiaries. These differences, for which data were unavailable, are neither discussed nor employed in this study.

Wilcox (1973), Kinney (1973), Gentry et al. (1985), and Casey and Bartczak (1985), among others, have tested whether cash-flow data and related measures lead to accurate classification of failed and nonfailed industrial firms. These studies focused on cash-flow and classification patterns of financial ratios (see also Gombola and Ketz 1983). The more recent studies indicate that consideration of financial ratios based on cash-flow measures does not improve the classification results of failed and nonfailed industrial companies. Several other previous studies focused on the ability of accounting information to predict financial distress. The ability of the decision maker to use alternate sets of information, such as current and replacement cost data, in the prediction of insolvency of publicly traded companies has also been examined (Beaver 1968; Elam 1975; Altman 1976; Ketz 1978; Norton and Smith 1979; Solomon and Beck 1980; Mensah 1983). Most of the early studies were summarized in Ball and Foster (1982) and Zavgren (1983). Despite the general success of previous studies in measuring the varying bankruptcy predictive abilities of different sets of data, none has focused on both market values of assets and cash-flow figures. Rather, they were concerned with industrial companies, where market values of many assets, such as property, plant, and equipment, were not available. Both market values of assets and cash-flow earnings numbers, however, are readily available for insurance companies.

II. Research Method

Sample of Insurance Companies

Financial data for most insurance companies are available from A. M. Best Company.[4] While the A. M. Best database was the major source of data, many financial statements were also obtained from a state insurance department. For the purpose of this study, failed insurers are those companies declared insolvent by state commissioners or by courts.[5] Insolvency usually did not occur when liabilities exceeded assets, or when other stated specific relationships existed between accounting variables under SAP (e.g., only in nine out of 105 insolvent insurers did liabilities exceed assets less than one year prior to bankruptcy). Instead, insurance departments determine insolvency based on close investigation of all schedules in the annual statements, including market data, cash-flow streams, details of contractual liabilities, and other stochastic reserves. Other useful information is developed from *ex ante* assessment of current business, potential new business not declared on the financial statements, management's ability, potential new ownership, and other considerations.

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[4] The A.M. Best file includes only insurers that meet a minimum premium volume requirement. Very small insurers are not listed (approximately one-third of solvent P&L insurers). Although the most appropriate sampling would include data from all existing nonfailed companies, the cost would exceed most research budgets. Most previous studies on financial distress used a distressed firm sample rate of about 50 percent. Even those few studies that used the entire COMPUSTAT industrial file obtained a failure rate in excess of the actual failure rates reported by Dunn and Bradstreet.

A sample of 105 P&L companies that failed during the period 1975–1987 is used in this study.[6] The distribution of sample firms across years is similar to the insolvency distribution reported by A. M. Best. The annual frequency rate of failure of P&L insurers in the U.S. was about 1.3 percent in 1975, but it has since ranged from .36 percent to 1.13 percent.[7] The insolvent insurers were matched with 106 P&L insurers selected at random from A. M. Best files. Matching was based on approximately comparable size, and for years in which data were available for insolvent insurers. Solvent insurers (or groups of companies) with total assets over $700 million were excluded from the sampled population because insolvent insurers ranged from $0.4 million and $700 million in assets. The solvent and insolvent samples were each split into an estimation sample and a holdout sample. A time-series holdout sample was selected (see Joy and Tollefson 1975; Dopuch et al. 1987). There are 66 solvent and 66 insolvent insurers in the estimation sample with data terminating before 31 December 1982, and 40 solvent and 39 insolvent insurers in the holdout sample with data terminating after that date. Thus, the estimation period is 1975–1983, whereas the holdout period is 1984–1987.[8]

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[5] Failed P&L insurers have been defined as companies placed on conservatorship, receivership, or liquidation (the term varies from state to state). This definition differs from that of Harmelink (1973). Insolvency is usually determined by the courts, based on procedures initiated by the regulators, but in several states the insurance commissioner has the authority to suspend operations of a company without concomitant or prior court authorization.

[6] Three successfully rehabilitated companies, as well as a few insurers that were compelled to cease operations through court action or other judicial procedures, are included in the sample of failed insurers. Five failed insurers were excluded from the analysis three years prior to insolvency because time-series data of at least five years duration were not available. Most solvent and insolvent sample P&L insurers cover automobile insurance and the multiple perils of home and farm owners. Many firms also cover commercial claims as well.

[7]

Year	*Failure Rate per 1000 P&L Insurers*	Year	*Failure Rate per 1000 P&L Insurers*
1975	12.8	1981	4.6
1976	7.2	1982	3.6
1977	5.5	1983	3.6
1978	7.5	1984	9.0
1979	5.8	1985	11.3
1980	4.2	1986	6.3
		1987	5.8

Source: A. M. Best reports. Note the comparable 1975–1976 and 1984–1985 failure rates.

[8] Time-series holdout samples have been selected instead of random cross-sectional holdout samples in most recent studies (Zavgren 1985; Palepu 1986; Dopuch et al. 1987). Dopuch et al. (1987) present three reasons

Logit Analysis and Model Estimation

A logit probability analysis is used for predicting financial distress in the P&L insurance industry.[9] McFadden (1974) developed the mathematical analysis of the logit model and the maximum likelihood function. These and other conditional probability models were expanded by Amemiya (1981) and Maddala (1983). Ohlson (1980) was among the first to employ logit models to predict bankruptcies among industrial firms.[10] The logit model is expressed by a cumulative distribution function $F(z)$:

$$F(z)=1/(1+e^{-Z}) \tag{1}$$

where Z is a linear combination of the independent variables of the form:

$$Z_j=W_1X_1+W_2X_2+\ldots+W_pX_p \tag{2}$$

where $(W_1,\ldots,W_p)$ is the vector of coefficients, and $X_1,\ldots,X_p$ are the independent variables (e.g., financial ratios and other financial measures in this study); $j=1,\ldots,N$ observations. If a random variable is identified as:

$$Y_j=\begin{cases}1 & \text{if the insurer goes bankrupt}\\ 0 & \text{otherwise}\end{cases}$$

then the *ex post* logit empirical model in the general form is $p=p(Y_j=1)=1/(1+e^{-Z_j})$.

Methodological flaws such as sample biases, misclassification costs, or use of an arbitrary cutoff probability are also considered here.[11] To correct for the oversampling of insolvent insurers the following adjustment is used (see Palepu 1986):

$$p_j'=p_j/[p_j+\alpha(1-p_j)]=1/(1+\alpha e^{-Z})=1/(1+e^{\ln\alpha-Z}) \tag{3}$$

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for selection of time-series holdout sample, among them that the cross-sectional holdout sample is more likely to exaggerate the model's predictive ability. Table 1 provides information about time-series stability of financial data for estimation and holdout samples. A cross-sectional holdout sample was also randomly drawn from the same time-period as the estimation sample. The estimation and holdout samples had the same sizes as the sample sizes for the time-series procedure. Although the cross-sectional holdout sample demonstrated slightly better predictive ability than the time-series holdout sample, it did not alter the conclusions across the three accounting procedures. These results are available upon request.

[9] Since the work of Altman (1968), Deakin (1972), Libby (1975), and others, MDA has been employed to predict bankruptcy in many industries, including the insurance industry (e.g., Harmelink 1973). A probit model was recently used by Zavgren (1985), Pastena and Ruland (1986), and Casey et al. (1986). Gentry et al. (1985) and Casey and Bartczak (1985) employed MDA and logit techniques to examine the ability of cash-flow data to classify bankrupt firms. Nonparametric analyses were employed by Frydman et al. (1985) and Marais et al. (1984). In this research MDA, probit, and nonparametric models are also used to assess the classification power and predictive ability of the three accounting procedures. Only the findings of the logit model are reported, but the MDA, probit, and nonparametric models do not alter the present conclusions.

[10] None of the failed insurers was publicly traded on stock exchanges. Thus, the market-based approach (e.g., measuring systematic risk or reporting stock price decline) cannot be applied (Aharony et al. 1980; Clark and Weinstein 1983). Several researchers have employed stock market variables in addition to financial statement variables for prediction models (Kaplan and Urwitz 1979; Palepu 1986; Dopuch et al. 1987).

[11] State-based (or choice-based) samples for model estimation produced biased coefficients. This and other sample selection biases are discussed in the econometric literature (see, e.g., Manski and Lerman 1977; Heckman 1979; Manski and McFadden 1981). Zmijewski (1984) specified three methodological issues in bankruptcy prediction models: choice-based sample biases (oversampling of insolvent firms), incomplete data availability for several firms, and the choice between several statistical specifications. Palepu (1986) addressed these and two additional issues: the use of choice-based samples in prediction tests, and the use of an arbitrary cutoff probability in classification and prediction procedures.

where p_j can be recovered by the equation:

$$p_j = 1/[(1/\alpha p_j') + 1 - 1/\alpha] = \alpha p_j'/(1 + \alpha p_j' - p_j') \tag{4}$$

where α is the probability that a solvent P&L insurer in the population is in the sample; p_j' is the Bayesian probability that a firm j in the sample is insolvent; and p_j is the estimated probability of being an insolvent firm in the population.

Independent Variables

Previous studies on the insurance industry have made use of financial ratios. Harmelink (1973) and Pinches and Trieschmann (1977) employed seven- and six-ratio MDA models, respectively, for predicting financially distressed insurers. Most of the ratios were underwriting-profitability and leverage ratios, and only two of those coincided. In addition to ratios used in prior studies (see Harmelink 1973; Trieschmann and Pinches 1973; Eck 1982), combined underwriting and investment profitability ratios, as well as variables measuring earning variability and stability of balance sheet items over time, are also used in this study.[12]

From a possible set of 32 financial ratios, five are chosen for analysis. These are as follows:

1. ROS = return on surplus (equity). The adjusted net income is divided by the owner's equity (surplus). Adjusted net income includes underwriting profits, investment income, and capital gains.
2. CROP = coefficient of stability of the profit margin ratio of return to premiums (revenues), ROP. This coefficient of stability is defined as the ratio of the average return on revenue divided by the standard deviation of the return on revenue for a nine-year period.
3. CROS = coefficient of stability of the ratio return on equity (surplus) ROS, for a nine-year period.
4. DM = liabilities decomposition measure (Lev 1974, chap. 4). The liabilities decomposition measure is defined as:

$$DM = \sum_{i=1}^{K} Q_i \ell n(Q_i/P_i) \tag{5}$$

where:

i = category, or type of liabilities; $i = 1, \ldots, K$; and K is the number of different liabilities. There are four liability categories in this study ($K = 4$): unearned premium reserve; loss reserves; all liabilities other than equity; and surplus (equity);

Q_i = the relative proportion (share) of liability (item) i to total balance sheet for the last year of data; and

P_i = the relative proportion (share) of liability (item) i to total balance sheet for a year prior to the last year of data. $0 \leq Q_i \leq 1$, $0 \leq P_i \leq 1$.

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[12] Dambolena and Khoury (1980) used time-series data on financial ratios to predict insolvency among industrial firms. Lev (1971, 1974), Booth (1983), and others provide evidence that decomposition measures are useful in predicting financial distress and demonstrate remarkable results in classifying bankrupt and nonbankrupt firms.

5. NDM = new liabilities decomposition measure, which uses the absolute value of the natural logarithm of the ratio Q_i/P_i for calculating the new liabilities decomposition measure. The NDM is defined as:

$$NDM = \sum_{i=1}^{K} Q_i |\ell n(Q_i/P_i)|. \tag{6}$$

The major methodological emphasis in this paper is on the classification accuracy. Thus, one should not be overly concerned by moderately high correlation among independent variables. The use of both the DM and the NDM in the same logit model is reasonable, since the calculations based on the properties of the logarithm function reveal significant differences for the two variables across firms, although the two variables are not completely independent. The five-variable model correctly classified more insurers than a four-variable model that excluded the variable DM.

This five-variable subset was selected from the original 32 variables as the most efficient for the purpose of the present study. First, one-year-ahead prediction was used as a criterion in the logit analysis. The stepwise selection criterion was the maximum likelihood criterion (see Mensah 1983, 234). Second, over 800 combinations of five to eight variables postulated to reveal significant results were considered. Most subsets (two GAAP exceptions are explained below) were dominated, in terms of the highest percentage of correct classification and the maximum likelihood criterion, by the most efficient subset of five variables. These same five efficient variables (ROS, CROP, CROS, DM, and NDM) were selected from the logit analysis of both the SAP- and MVA-based data. Only one seven-variable logit model had a slightly better maximum likelihood index when the GAAP-based data were used. However, the efficient five variables dominated other combinations of five-variable models selected out of the seven-variable model on each and every run of the GAAP-based data. Similar results were obtained for three-years-ahead prediction.

III. Empirical Results

Because the financial measures deteriorated as the insurers moved from three years prior to insolvency to one year prior to the event, the results of this study are reported for one and three years prior to insolvency. These results are consistent with the findings of other studies (Beaver 1966; Ohlson 1980; Casey and Bartczak 1985; Gentry et al. 1985; Zavgren 1985). Test statistics indicate significant differences between the two periods for most variables.

Univariate Analysis

Table 1 presents the mean and median values of the five explanatory variables for each of the three accounting procedures, for the solvent and insolvent groups. Significant differences between the solvent and insolvent groups are shown for each accounting procedure, one and three years prior to insolvency. Panel A of table 1 summarizes the results of the estimation sample. Panel B of table 1 shows similar results for the holdout sample. For each variable, the mean or median for the solvent firms are similar at one and three years prior to insolvency for each accounting procedure. However, means and medians significantly differ across time for several variables when insolvent insurers were compared for the same two periods. In addition, differences between

Table 1

Summary Statistics—Independent Variables for Estimation (Sample Period: 1975–1983, 66 Solvent and 66 Insolvent Insurers) and Holdout (Sample Period: 1984–1987, 40 Solvent and 39 Insolvent Insurers) Samples: Means, Medians, and Test Statistics One and Three Years Prior to Insolvency

	Accounting Procedures[1]											
	SAP 1		MVA 1		GAAP 1		SAP 3		MVA 3		GAAP 3	
Sample[2]	*Solvent*[3]	*Insolvent*	*Solvent*[3]	*Insolvent*	*Solvent*[3]	*Insolvent*	*Solvent*[3]	*Insolvent*	*Solvent*[3]	*Insolvent*	*Solvent*[3]	*Insolvent*
Variable and Statistic												
Panel A. Estimation Sample:												
CROP												
Mean	1.391	−.091	1.388	−.105	1.770	.138	1.386	−.054	1.367	.141	1.762	.084
Median	1.324	−.071	1.300	−.063	1.718	.140	1.216	.182	1.209	.219	1.671	.309
t-statistic[4]	−11.9[a]		−12.3[a]		−10.5[a]		−5.1[a]		−8.0[a]		−6.0[a]	
MWW statistic	8.9[a]		9.0[a]		8.3[a]		7.3[a]		7.3[a]		−6.9[a]	
CROS												
Mean	1.454	−.271	1.833	−.112	1.837	−.004	1.428	.054	1.776	.363	1.842	−.013
Median	1.330	−.197	1.659	−.121	1.634	.052	1.241	.093	1.606	.287	1.603	.131
t-statistic[4]	−11.6[a]		−11.5[a]		−11.2[a]		−7.4[a]		−5.6[a]		−6.0[a]	
MWW statistic	9.0[a]		8.6[a]		8.7[a]		7.1[a]		6.7[a]		7.2[a]	
ROS												
Mean	.233	−.520	.309	−1.038	.248	.187	.201	−.129	.313	−.033	.219	.093
Median	.238	−.293	.294	−.471	.252	−.130	.180	.060	.301	.111	.227	.103
t-statistic[4]	−6.8[a]		−5.1[a]		1.0[a]		−3.3[a]		−3.5[a]		−2.5[b]	
MWW statistic	8.2[a]		8.4[a]		5.6[a]		4.2[a]		4.1[a]		3.6[a]	
DM												
Mean	.014	.127	.030	.152	.014	.092	.009	.096	.014	.104	.011	.092
Median	.005	.078	.005	.076	.009	.053	.005	.028	.007	.038	.005	.032
t-statistic[4]	4.9[a]		3.2[b]		3.5[a]		3.3[a]		3.3[a]		3.4[a]	
MWW statistic	−7.8[a]		6.9[a]		−7.4[a]		−5.9[a]		−5.7[a]		−5.9[a]	
NDM												
Mean	.083	.340	.117	.349	.096	.352	.090	.259	.097	.263	.069	.256
Median	.066	.245	.061	.255	.071	.245	.076	.169	.080	.165	.078	.180
t-statistic[4]	7.0[a]		4.7[a]		5.3[a]		4.4[a]		4.3[a]		4.5[a]	
MWW statistic	−8.3[a]		−7.4[a]		−7.6[a]		−5.9[a]		−5.2[a]		−5.6[a]	

Table 1—*Continued*

	Accounting Procedures[1]											
	SAP 1		MVA 1		GAAP 1		SAP 3		MVA 3		GAAP 3	
Sample[2]	Solvent[3]	Insolvent	Solvent[3]	Insolvent	Solvent[3]	Insolvent	Solvent[3]	Insolvent	Solvent[3]	Insolvent	Solvent[3]	Insolvent
Panel B. Holdout Samples:[5]												
CROP[4]												
Mean	1.502	−.014	1.494	−.036	1.535‡	.242	1.596	.102‡	1.504	.170	1.528	.288‡
Median	1.392	−.040	1.474	−.079	1.573	.155	1.438	.308	1.334	.222	1.413	.437
CROS[4]												
Mean	1.609	−.161	1.849	−.130	1.582	.146‡	1.713	.241‡	1.903	.399	1.564‡	.219†
Median	1.470	−.165	1.717	−.135	1.465	.117	1.467	.175	1.546	.343‡	1.369‡	.345‡
ROS[4]												
Mean	.197	−.592	.302	−1.031	.195[c]	.305[c]	.190	−.187	.368	−.168	.207	−.155
Median	.215	−.290	.280	−.359	.216	−.127	.164	.024	.274	.096	.209	.103
DM[4]												
Mean	.026	.153	.036	.152	.029	.153	.016	.106	.019	.109	.028	.096
Median	.008	.072	.006	.066	.008	.072	.007	.032	.007	.032	.008	.034
NDM[4]												
Mean	.116	.361	.139	.351	.121	.353	.106	.271	.110	.266	.117	.269
Median	.064	.244	.091	.264	.081	.252	.079	.173	.084	.166	.067	.160

[1] The three accounting procedures are the Statutory Accounting Principles (SAP), Generally Accepted Accounting Principles (GAAP), and Market Value Adjustments and Cash-Flow Figures procedure (MVA). The last year prior to insolvency is denoted by 1 (SAP 1, MVA 1, GAAP 1) and three years prior to insolvency by 3 (SAP 3, MVA 3, GAAP 3). Variables are defined in table 2, note 4.

[2] Solvent (Sol), Insolvent (Insol).

[3] The statistics for the solvent samples are similar for both periods. Pair comparisons of solvent samples between one and three years prior to insolvency are statistically insignificant.

[4] The t-statistic (the Mann-Whitney-Wilcoxon statistic) tests whether the mean (median) of the solvent and insolvent samples are different.

[5] Means (medians) of solvent and insolvent holdout samples differ significantly, unless indicated as insignificant.

[6] Differences between statistics for the estimation and holdout samples are insignificant. A few exceptions are significant at .01 (†) or .05 (‡). For example, CROS for insolvent insurers in the estimation sample differs significantly from CROS for insolvent insurers in the holdout sample when the GAAP procedure is tested three years prior to insolvency.

[a] Significant at .001.

[b] Significant at .01.

[c] Insignificant.

Table 2
Profile Comparisons of Independent Variables and Pairwise Correlations for Estimation Sample (Sample Period: 1975–1983)

Panel A. Test Statistics:

	Variables:	*CROP*	*CROS*	*ROS*	*DM*	*NDM*
One Year Prior	*Solvent* (66 Insurers)					
Joint χ^{2g}		25.7^a	31.4^a	57.9^a	$.37^*$	$.37^*$
Wilcoxon^h	SAP vs. MVA^i	-1.98^c	-4.9^a	-6.4^a	1.14^*	-1.2^*
	SAP vs. GAAP	-4.2^a	-4.1^a	$-.48^*$	$-.76^*$	$-.92^*$
	MVA vs. GAAP	-4.3^a	$.95^*$	-5.1^a	$-.11^*$	$-.28^*$
	Insolvent (66 Insurers)					
Joint χ^{2g}		25.1^a	30.0^a	17.3^a	5.8^c	2.3^*
Wilcoxon^h	SAP vs. MVA^i	-1.45^*	-1.2^*	-1.91^d	$-.2^*$	$-.40^*$
	SAP vs. GAAP	-5.3^a	-4.5^a	-3.3^a	-1.45^*	$-.84^*$
	MVA vs. GAAP	-4.4^a	-4.3^a	-3.7^a	-2.5^a	$-.97^*$
Three Years Prior	*Solvent* (66 Insurers)					
Joint χ^{2g}		32.0^a	26.3^a	60.2^a	2.06^*	1.88^*
Wilcoxon^h	SAP vs. MVA^i	-1.97^a	-4.2^a	-5.5^a	-1.93^d	-1.49^*
	SAP vs. GAAP	-4.2^a	-4.2^a	-3.2^b	$.20^*$	$-.42^*$
	MVA vs. GAAP	-4.3^a	$-.50^*$	-4.7^a	-1.55^*	-1.45^*
	Insolvent (65 Insurers)					
Joint χ^{2g}		18.5^a	19.6^a	9.3^a	2.79^d	1.31^*
Wilcoxon^h	SAP vs. MVA^i	$-.60^*$	-3.9^a	-2.32^a	$-.97^*$	$-.73^*$
	SAP vs. GAAP	-3.6^a	-2.9^b	-3.08^b	1.56^*	1.09^*
	MVA vs. GAAP	-3.1^b	-2.31^a	$-.03^*$	1.68^d	1.30^*

Panel B. Pairwise Correlations:^{j}

Variable^i	*Group*	*SAP 1 vs. MVA 1*	*SAP 1 vs. GAAP 1*	*MVA 1 vs. GAAP 1*	*SAP 3 vs. MVA 3*	*SAP 3 vs. GAAP 3*	*MVA 3 vs. GAAP 3*
CROP	Insolvent	.792	.539	.384	.420	.508	.333
	Solvent	.815	.294	.206	.833	.396	.237
	Overall	.893	.536	.458	.622	.550	.420
CROS	Insolvent	.300	.304	.043	.367	.384	.531
	Solvent	.695	.192	.142	.638	.208	.176
	Overall	.751	.438	.345	.604	.434	.407
ROS	Insolvent	.162	.011	−.358	.732	.290	.256
	Solvent	.689	.383	.286	.645	.425	.325
	Overall	.254	.004	−.335	.726	.324	.286

data for the estimation and holdout samples are often insignificant. These results indicate that stability of data over time exists for the event of interest.

Table 2 shows the effect of three accounting procedures (SAP, MVA, and GAAP) on the five explanatory independent variables. Test statistics for these variables are presented in panel A of table 2. There are significant differences among the effects of the accounting procedures on many of the variables. However, several comparisons are insignificant, and for a few variables such as the NDM all the differences are insignificant. Panel B of table 2 summarizes the pairwise correlations for the five efficient vari-

TABLE 2—*Continued*

Panel B. Pairwise Correlations—Continued:[f]

Variable[j]	*Group*	*SAP 1 vs. MVA 1*	*SAP 1 vs. GAAP 1*	*MVA 1 vs. GAAP 1*	*SAP 3 vs. MVA 3*	*SAP 3 vs. GAAP 3*	*MVA 3 vs. GAAP 3*
DM	Insolvent	.725	.520	.829	.845	.910	.908
	Solvent	.138	.328	.001	.191	.352	.052
	Overall	.672	.546	.729	.843	.898	.887
NDM	Insolvent	.680	.603	.815	.865	.868	.817
	Solvent	.138	.228	.259	.242	.301	.273
	Overall	.619	.630	.732	.819	.865	.792
Average for Overall		.638	.431	.386	.723	.614	.558

[a] Significant at .001.
[b] Significant at .01.
[c] Significant at .05.
[d] Significant at .10.
[f] See note 1, table 1.
[g] The χ^2 statistic (Friedman ANOVA) tests whether the three distributions of the univariate variables (obtained by SAP, MVA, GAAP) are different.
[h] The Wilcoxon matched-pairs statistic tests whether the univariate variable measured by SAP versus MVA (SAP versus GAAP, or MVA versus GAAP) differs in centers (medians).
[j] ROS = Return on surplus (equity). The adjusted net income is divided by the owner's equity (surplus).
CROS = Coefficient of stability of the ratio return on equity (surplus) ROS. This is the ratio of the average return on surplus divided by the standard deviation of the return on surplus for a nine-year period.
CROP = Coefficient of stability of the ratio of return to revenues (premiums), ROP, for a nine-year period.

DM = Liabilities decomposition measure, $\sum_{i=1}^{k} Q_i \ell n(Q_i/p_i)$.

NDM = New liabilities decomposition measure, $\sum_{i=1}^{k} Q_i |\ell n(Q_i/p_i)|$.
* Insignificant.

ables. The higher the pairwise correlation, the less likely it is that there will be incremental predictive ability in any one procedure, given that the other procedure has already been used to measure the classification. Relatively higher correlations are presented by the variables DM and NDM, and the lowest pairwise correlations are presented by ROS. The results also indicate that the incremental predictive ability of MVA versus GAAP is higher than SAP versus GAAP; while the higher (lower) pairwise correlations (incremental classification power) are generally indicated by SAP versus MVA. However, on the average, only 41 percent (0.638^2) of the variation in SAP variables is explained by variation in MVA variables, indicating that MVA differs substantially from SAP. There are at least two reasons for these results. First, premiums written by solvent insurers have had substantial annual growth since 1970, and cash flows were usually much higher than accrual revenues. Second, insurers have held bond portfolios for long durations and their amortized values differ from their market values.

Table 3

Logit Model Estimations Across Accounting Procedures: Coefficients, Log-Likelihood Ratios, χ^2 Statistics of the Log-Likelihood Ratio, and R^2

Accounting Coefficients for Estimation Sample	Predicted Sign	Procedure[1]					
		One Year Prior to Insolvency			*Three Years Prior to Insolvency*		
		SAP 1	*MVA 1*	*GAAP 1*[3]	*SAP 3*	*MVA 3*	*GAAP 3*[4]
CROP	−	−.498	−2.067[c]	1.179	−.681	−1.896[b]	.465
CROS	−	−1.815	−.527	−3.477[b]	−.968	.023	−1.812[c]
ROS	−	−3.104[c]	−3.425[b]	.274	−.959	−.753	−.258
DM	+	−13.899	−16.117[c]	4.024	7.005	−1.807	.625
NDM	+	13.805[c]	13.852[c]	6.004	7.128[d]	7.487[d]	10.531[c]
Constant		−.662	−.099	.372	.211	.491	−.076
Log-Likelihood		−24.38	−23.27	−34.80	−53.60	−54.51	−54.91
χ^2-statistic		134.2[a]	135.4[a]	113.4[a]	74.4[a]	72.6[a]	72.2[a]
R^2[2]		0.73	0.74	0.62	0.41	0.40	0.40

[1] See note 1, table 1.

[2] The pseudo R^2 is equal to: 1 − log-likelihood at convergence/log-likelihood at zero (constrained).

[3] The log-likelihood, χ^2, and the pseudo R^2 of the first seven GAAP variables selected from a stepwise logit analysis one year prior to insolvency are: −34.53, 113.9, and .62, respectively. This seven-variable subset includes the variables CROP, CROS, ROS, NDM, and three additional variables.

[4] The log-likelihood, χ^2, and the pseudo R^2 of the first five GAAP variables selected from a stepwise logit analysis three years prior to insolvency are: −54.47, 72.7, and .40 respectively. This five-variable subset includes the variables CROP, CROS, NDM, and two additional variables.

[a] Significant at .00001.

[b] Significant at .01.

[c] Significant at .05.

[d] Significant at .10.

Logit Estimates for the Estimation Sample

Table 3 reports predicted signs, estimated coefficients, and goodness-of-fit measures (i.e., the log-likelihood ratio and the R^2). Results for the five-variable logit model are presented for one and three years prior to insolvency across the three alternative accounting practices. The three accounting procedures are denoted SAP 1, GAAP 1, and MVA 1 for one year prior to insolvency, and SAP 3, GAAP 3, and MVA 3 for three years prior to the event. The strongest results are produced for one year prior to insolvency, but they are still significant three years prior to the event.

In general, the MVA procedure produces the strongest statistical results one year prior to insolvency. the χ^2 statistic for the log likelihood is 135.4, which is significant at $p < 0.001$ level; the pseudo R^2 of the model is 0.74. SAP produced similar results, but GAAP produced weaker, though highly significant, results. All three accounting procedures, however, generate similar statistics three years prior to insolvency. These statistics are significant, but their relative magnitude is lower than it is for statistics one year before the event. The sign and relative magnitude of each coefficient were generally similar across SAP and MVA, but GAAP often produced different coefficients. In the SAP and MVA models, the variables have the expected signs indicating that lower CROP, CROS, and ROS and higher NDM are likely to be better indicators of the probability of insolvency. The signs of the DM are negative and opposite to the direction predicted. Most coefficients for the GAAP procedure (one year before insolvency) are insignificant and have signs contrary to the predicted hypothesis. Thus, SAP and MVA produce more significant statistics, and more significant coefficients in the predicted direction, compared to GAAP, especially one year prior to insolvency.

Estimated Probabilities

Table 4 summarizes estimated probabilities from the adjusted logit model (p) for both estimation and holdout samples. The mean and median probabilities are significantly higher for insolvent insurers in the estimation sample than those for solvent insurers. Test statistics also indicate that the SAP and the MVA logit's estimated probabilities for solvent and insolvent insurers differ more significantly than estimated probabilities obtained by the GAAP logit model.

Table 4 also contains joint χ^2 statistics and the Wilcoxon matched-pairs statistics to test for differences in estimated probabilities across accounting procedures for estimation and holdout samples for both solvent and insolvent groups of insurers. The joint χ^2 tests are highly significant for the estimation sample and indicate that distributions of the estimated probabilities are different across the three accounting procedures. The results for the holdout sample are not as strong as for the estimation sample, but the test statistics are still significant for solvent companies for both time periods. The pair-matched test statistics indicate that means and medians of estimated probabilities for each comparison of two accounting procedures differ significantly. Weaker results, however, are generally obtained for SAP versus MVA, whereas some comparisons were insignificant for the holdout sample.

Classification and Predictive Ability

The five-variable model correctly classified 93.2 percent, 94.7 percent, and 90.9 percent of the P&L insurers for the SAP, MVA, and GAAP analyses, respectively, one year prior to insolvency. A cutoff score of 0.5 was selected for this preliminary analysis of the estimation sample. At three years prior to insolvency, the five-variable model correctly classified 83.2 percent, 82.4 percent, and 80.9 percent of the insurers for the SAP, MVA, and GAAP analyses, respectively.

Table 5 shows the classification obtained with the five-variable logit functions. A cufoff score was selected to minimize the number of misclassifications in the estimation sample.[13] Results indicate that the MVA and the SAP procedures outperform the GAAP data set for each year.

The hypothesis that models predicated on market- and cash-flow-based data have greater ability to classify financial solvency problems is tested in panel A of table 5. The null hypothesis is that financial measures computed from the three alternate sets of accounting data have the same predictive ability. This proposition is tested against the hypothesis that at least one procedure is different from the others in terms of predictive ability. The approximated χ^2 joint test (see Conover 1971) shows that the null hypothesis is rejected one year prior to insolvency. However, the null hypothesis cannot be re-

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[13] This cutoff score, which minimizes the overall sample error, implies that the expected costs of a Type I error (identifying an insolvent insurer as solvent) and a Type II error (identifying a solvent insurer as insolvent) are equal.

Table 4

Summary of Estimated Probabilities for One and Three Years Prior to Insolvency (P adjusted for oversampling of insolvent insurers)

Procedure[1]	*SAP 1*		*MVA 1*		*GAAP 1*		*SAP 3*		*MVA 3*		*GAAP 3*	
Sample	*Solvent*	*Insolvent*	*Solvent*	*Insolvent*	*Solvent*	*Insolvent*	*Solvent*	*Insolvent*	*Solvent*	*Insolvent*	*Solvent*	*Insolvent*
Estimation Sample (66 Solvent and 66 Insolvent)												
Mean	.048	.734	.044	.733	.058	.618	.077	.469	.060	.454	.089	.465
Median	.004	.889	.004	.896	.008	.702	.031	.464	.031	.362	.040	.389
Std. Dev.	.154	.313	.163	.313	.165	.315	.146	.352	.153	.340	.160	.320
Minimum	.000	.053	.000	.067	.000	.018	.000	.009	.000	.015	.000	.043
Maximum	.815	1.000	.982	1.000	.985	1.000	.871	1.000	.875	1.000	.904	1.000
t-statistic[2]	16.0^{a}		15.9^{a}		12.8^{a}		8.3^{a}		8.1^{a}		6.5^{a}	
MWW[2]	−9.5^{a}		−9.5^{a}		−9.1^{a}		−7.9^{a}		−7.8^{a}		−8.0^{a}	
χ^2 joint tests:[3]			Solvent 75.0^{a}, Insolvent 97.7^{a}						Solvent 67.5^{a}, Insolvent 18.0^{a}			
Wilcoxon[4] Solvent:			(1) −3.83^{a}, (2) −5.11^{a}, (3) −5.68^{a}						(4) −2.19^{c}, (5) −6.29^{a}, (6) −5.68^{a}			
Insolvent:			(1) −1.81^{c}, (2) −6.74^{a}, (3) −6.79^{a}						(4) −3.57^{a}, (5) −.47^{d}, (6) −2.63^{b}			
Holdout Sample (40 Solvent and 39 Insolvent)												
Mean	.099	.659	.072	.644	.239	.486	.114	.468	.065	.468	.258	.361
Median	.001	.805	.002	.862	.054	.431	.012	.344	.013	.436	.130	.225
Std. Dev.	.216	.351	.189	.377	.311	.386	.236	.370	.174	.350	.303	.351
Minimum	.000	.000	.000	.000	.000	.003	.000	.000	.000	.002	.000	.006
Maximum	.914	1.000	.996	1.000	1.000	1.000	.899	1.000	.748	1.000	.975	1.000
t-statistic[2]	6.38^{a}		7.49^{a}		2.87^{b}		5.00^{a}		6.08^{a}		1.61^{d}	
MWW[2]	−6.22^{a}		−5.69^{a}		−2.83^{b}		−5.20^{a}		−5.66^{a}		−1.95^{d}	
χ^2 joint tests:[3]			Solvent 17.2^{a}, Insolvent 3.23^{d}						Solvent 23.7^{a}, Insolvent 1.33^{d}			
Wilcoxon[4] Solvent:			(1) −.15^{d}, (2) −3.32^{a}, (3) −3.56^{a}						(4) −.14^{d}, (5) −2.99^{b}, (6) −4.45^{a}			
Insolvent:			(1) −.28^{d}, (2) −1.69^{d}, (3) −1.59^{d}						(4) −.12^{d}, (5) −.79^{d}, (6) −2.19^{c}			

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[1] See note 1, table 1.

[2] The t-statistic (the Mann-Whitney-Wilcoxon statistic) tests whether the mean (median) estimated probabilities of the solvent and insolvent samples are different.

[3] The χ^2 statistic (Friedman ANOVA) tests whether the three distributions of the estimated probabilities are different; for example, differing in centers (medians).

[4] The Wilcoxon matched-pairs statistic tests whether the estimated probabilities of two accounting procedures differ in centers (medians): (1) SAP 1 versus MVA 1; (2) SAP 1 versus GAAP 1; (3) MVA 1 versus GAAP 1; (4) SAP 3 versus MVA 3; (5) SAP 3 versus GAAP 3; (6) MVA 3 versus GAAP 3.

^{a} Significant at 0.001.

^{b} Significant at 0.01.

^{c} Significant at 0.05.

^{d} Insignificant.

Table 5
Classification and Predictive Ability of the Three Accounting Procedures One and Three Years Prior to Insolvency

	One Year Prior to Insolvency			*Three Years Prior to Insolvency*		
Accounting Procedure	*SAP 1*	*MVA 1*	*GAAP 1*	*SAP 3*	*MVA 3*	*GAAP 3*
Panel A:						
Estimation Sample						
Classification (%):[2] P (adjusted), Minimization of Errors Criterion						
Insolvent	100.0	100.0	90.9	80.0	81.5	81.5
Solvent	92.4	92.4	90.9	86.4	84.6	80.3
Overall	96.2	96.2	90.9	83.2	83.2	80.9
Joint *t*-statistic test:[3]	4.72[d]			.32*		
t-statistic:[3]	SAP or MVA vs. GAAP 3.08[c]			SAP or MVA vs. GAAP .23*		
Classification (%):[2] Naive Model,[4] Minimization of Errors Criterion						
Insolvent	84.8	83.3	72.7	71.2	72.7	59.1
Solvent	81.8	84.8	77.2	66.1	64.6	61.5
Overall	83.3	84.0	75.0	68.7	68.7	60.3
Joint *t*-statistic test:[3]	4.33*			2.74*		
t-statistic:[3]	SAP vs. GAAP 2.78[c] MVA vs. GAAP 3.35[c]			SAP or MVA vs GAAP 2.02[d]		
Holdout Sample						
Classification (%):[2] P (adjusted)						
Insolvent	92.5	87.7	71.8	74.3	80.0	60.0
Solvent	77.5	85.0	72.5	77.5	85.0	52.5
Overall	84.8	86.1	72.2	76.0	82.7	56.0
Joint *t*-statistic test:[3]	6.08[c]			14.19[a]		
t-statistic:[3]	SAP vs. GAAP 3.75[c] MVA vs. GAAP 4.63[b]			SAP vs. GAAP 6.84[a] MVA vs. GAAP 12.54[a]		
Classification (%):[2] Naive Model[4]						
Insolvent	71.7	69.2	51.2	71.4	68.6	45.7
Solvent	75.0	80.0	55.0	57.5	62.5	42.5
Overall	73.7	74.7	53.1	64.0	65.3	44.0
Joint *t*-statistic test:[3]	10.43[a]			8.78[b]		
t-statistic:[3]	SAP vs. GAAP 6.97[a] MVA vs. GAAP 7.93[a]			SAP vs. GAAP 6.04[a] MVA vs. GAAP 6.78[a]		

jected for three years prior to insolvency for the estimation sample. Various pairwise comparisons are evaluated wherever the classification ability of at least one procedure was different from the other. In general, both MVA and SAP improved the predictive ability of the financial measures compared with GAAP. Observations in the holdout sample are classified with cutoff scores that minimize the number of misclassifications in the estimation sample. The joint χ^2 tests indicate significant differences in the predictive ability of the accounting procedures one and three years prior to insolvency. Thus, the null hypotheses are rejected for the holdout sample. The pairwise comparisons show that both MVA and SAP improved the predictive ability of the financial measures compared with GAAP, while MVA and SAP comparisons demonstrated similar results and insignificant differences.

The classification accuracy and predictive ability of the five-variable logit model

Table 5—*Continued*

	SAP & MVA 1	*SAP & GAAP 1*	*MVA & GAAP 1*	*SAP & MVA 3*	*SAP & GAAP 3*	*MVA & GAAP 3*
Panel B						
Estimation Sample						
Classification (%):[2] *P* (adjusted), Minimization of Errors Criterion						
Insolvent	100.0	95.4	97.0	83.1	83.1	81.5
Solvent	93.9	93.9	95.4	87.9	87.9	89.4
Overall	96.9	94.7	96.2	85.5	85.5	85.5
t-statistic:[3]	SAP & MVA vs. GAAP 4.26[b]			SAP & MVA vs. GAAP .98*		
	SAP & GAAP vs. MVA .35*			SAP & GAAP vs. MVA.26*		
	MVA & GAAP vs. SAP 0.0*			MVA & GAAP vs. SAP .26*		
Holdout Sample						
Classification (%):[2] *P* (adjusted)						
Insolvent	84.6	79.5	76.9	85.5	65.7	51.4
Solvent	75.0	75.0	72.5	77.5	82.5	75.0
Overall	79.7	75.9	74.9	81.3	74.7	64.0
t-statistic:[3]	SAP & MVA vs. GAAP 1.25*			SAP & MVA vs. GAAP 11.19[a]		
	SAP & GAAP vs. MVA 2.06[d]			SAP & GAAP vs. MVA 1.02*		
	MVA & GAAP vs. SAP 2.51[d]			MVA & GAAP vs. SAP 1.59*		

[1] See note 1, table 1.

[2] Percentage of insurers correctly classified.

[3] The *t*-statistics are expanded by Conover (1971, 141–54). The distributions of the *t*-statistics are approximately χ^2 with two and one degrees of freedom for the joint (two-tailed) test and the pairwise (one-tailed) test, respectively.

[4] The naive model is a combination of the five univariate ratios. The insurers were classified either solvent or insolvent, with correct classification defined as three of five univariate variables agreed with the classification.

[a] Significant at .01.

[b] Significant at .025.

[c] Significant at .05.

[d] Significant at .10.

* Insignificant.

were compared to those of naive models. In panel A of table 5, classifications and predictions of one naive model, a combination of the five univariate ratios, are presented. The P&L insurers were classified as either solvent or insolvent when at least three of the five univariate variables agreed with the classification. Classification and the predictive ability of the five-variable logit model were significantly more accurate than those of the naive model. Even with the naive model, however, both MVA or SAP measures were significantly more predictive than GAAP measures for both estimation and holdout samples.[14] Panel B of table 5 summarizes the incremental predictive ability of: SAP and MVA given GAAP; SAP and GAAP given MVA; and MVA and GAAP given SAP. The test statistics indicated statistically significant incremental classification accuracy and predictive ability in the combined SAP and MVA, given GAAP for the estimation sample one year prior to insolvency, and for the holdout sample three years prior to the event. The null hypotheses were usually not rejected for the other comparisons. In conclusion, financial measures computed from MVA, SAP, or the combined MVA and SAP, were significantly more accurate for the classification of insolvencies than were those measures computed with GAAP for both estimation and holdout samples.

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[14] Similar significant findings were obtained by various other naive models and a reduced three-variable logit model, although these results are not reported in this study. Examination of estimated coefficients and goodness-of-fit measures, by an approach similar to the one taken by Beaver and Landsman (1983), also indicates significant incremental predictive ability in SAP and MVA given GAAP, while the other comparisons were insignificant.

Prior Probabilities and Misclassification Costs

The empirical results were further analyzed for various levels of prior probabilities and misclassification costs. The expected cost of misclassification (ECM), which is considered a measure of risk, is illustrated in table 6. The ECM is calculated as follows:

$$ECM=\pi_1 c_1 n_1/N_1+\pi_2 c_2 n_2/N_2 \tag{7}$$

where n_i=the total number of type i misclassifications; N_i=sample size of the ith group; $i=1$ (i.e., insolvent group), or 2 (i.e., solvent group). The prior probabilities of the insolvent and the solvent groups were $\pi_1=0.02$ and $\pi_2=0.98$, respectively. The misclassification cost for a Type II error was fixed at $C_2=1$, while the misclassification cost for a Type I error (identifying an insolvent insurer as a solvent one), C_1, ranged from one to 100. A cutoff score was selected to minimize the ECM for each C_1 in the estimation sample. Insurers in the holdout sample are then classified with those cutoff scores. The ECM of insurers by the various accounting procedures are presented in table 6. The ECMs of the model are compared with a naive approach that classifies all insurers into the group with the higher prior probability; that is, the solvent group (for discussion and elaboration, see Dopuch et al. 1987, 444–45). The ECM of the naive strategy is then compared with the minimization of the ECM criterion. Results reveal that minimizing the ECM generates relatively low costs compared with the naive strategy. The nonparametric test statistics indicate that SAP or MVA significantly outperform GAAP measures in terms of lower expected cost of misclassification for both estimation and holdout samples.

The ECM for all misclassification costs are also illustrated in figures 1 and 2 for the estimation sample and holdout sample, respectively. The ECM with GAAP measures are higher than those with SAP and MVA measures for both samples and both periods. The results for MVA measures versus SAP measures are inconclusive. MVA and SAP produce similar results in the estimation sample, but in the holdout sample SAP slightly dominates MVA at one year prior to insolvency and MVA slightly dominates SAP three years before the event. In conclusion, MVA and SAP measures outperform GAAP measures for all levels of misclassification costs studied.

IV. Summary and Concluding Remarks

This study provides evidence for the association between market- and cash-flow-based data and the ability to classify and predict insolvencies in the P&L industry. Results indicate that the SAP and/or MVA measures yield incremental gains beyond GAAP measures. These results should be of use to policymakers, regulators, policyholders, researchers, and auditors, because decisions concerning distressed insurers are systematically related to the financial data of the insurance companies. The current study extends and updates Harmelink's (1973) research method and findings by explic-

Table 6

Expected Cost of Misclassification of P&L Insurers for Various Misclassification Costs of Type I Error, C_1[1]

	$C_1=$					
Accounting Procedure	*1* *ECM (Naive)*[2]	*5* *ECM (Naive)*[2]	*25* *ECM (Naive)*[2]	*50* *ECM (Naive)*[2]	*75* *ECM (Naive)*[2]	*100* *ECM (Naive)*[2]
Estimation Sample						
SAP 1	.008 (.400)	.041 (.410)	.074 (.148)	.074 (.074)	.074 (.049)	.074 (.037)
MVA 1	.014 (.700)	.045 (.450)	.074 (.148)	.074 (.074)	.074 (.049)	.074 (.037)
GAAP 1	.018 (.901)	.065 (.650)	.134 (.268)	.180 (.180)	.225 (.150)	.208 (.104)
Joint χ^2-statistic:[3] 11.2;[a] Wilcoxon:[4] SAP vs. MVA −1.34[*], SAP or MVA vs GAAP −2.20[b]						
SAP 3	.016 (.800)	.080 (.800)	.222 (.444)	.331 (.331)	.391 (.261)	.434 (.219)
MVA 3	.016 (.800)	.082 (.820)	.229 (.458)	.330 (.330)	.384 (.256)	.437 (.219)
GAAP 3	.017 (.850)	.092 (.920)	.243 (.486)	.361 (.361)	.430 (.286)	.500 (.250)
Joint χ^2-statistic:[3] 9.81;[a] Wilcoxon:[4] SAP vs. MVA −.18[*], SAP or MVA vs. GAAP −2.21[b]						
Holdout Sample						
SAP 1	.035 (1.75)	.078 (.780)	.320 (.640)	.345 (.345)	.371 (.247)	.397 (.189)
MVA 1	.040 (2.00)	.097 (.970)	.285 (.570)	.349 (.349)	.413 (.275)	.477 (.238)
GAAP 1	.042 (2.10)	.252 (2.52)	.545 (1.09)	.673 (.673)	.801 (.534)	.976 (.438)
Joint χ^2-statistic:[3] 10.3;[a] Wilcoxon:[4] SAP vs. MVA −1.33[*], SAP or MVA vs. GAAP−2.20[b]						
SAP 3	.039 (1.95)	.181 (1.81)	.318 (.636)	.388 (.388)	.459 (.306)	.531 (.265)
MVA 3	.015 (.772)	.077 (.770)	.280 (.560)	.335 (.335)	.392 (.260)	.449 (.225)
GAAP 3	.090 (4.50)	.373 (3.73)	.665 (1.33)	.865 (.865)	.882 (.588)	.939 (.469)
Joint χ^2-statistic:[3] 12.0;[a] Wilcoxon:[4] SAP vs. MVA−2.20[b], SAP or MVA vs. GAAP−2.20[b]						

[1] The expected cost of misclassification, ECM, is equal to $\pi_1 C_1 n_1/N_1 + \pi_2 C_2 n_2/N_2$; where n_i=total number of type i misclassifications, N_i=sample size of the ith group, $i=1, 2$; $C_2=1$, $\pi_1=0.02$, and $\pi_2=0.98$. Type I error is defined as classifying an insurer as solvent when it is insolvent; Type II error is defined as classifying an insurer as insolvent when it is solvent.

[2] Naive: the cost of model errors relative to cost of errors from a naive strategy, which is defined as classifying all insurers into the solvent group (with the higher prior probability).

[3] The χ^2 statistic (Friedman ANOVA) tests whether distributions of ECM for the three accounting procedures are different; for example, differ in centers.

[4] The Wilcoxon matched-pairs statistic tests whether the ECM of SAP versus MVA (SAP vs. GAAP, or MVA vs. GAAP) differs in centers (medians).

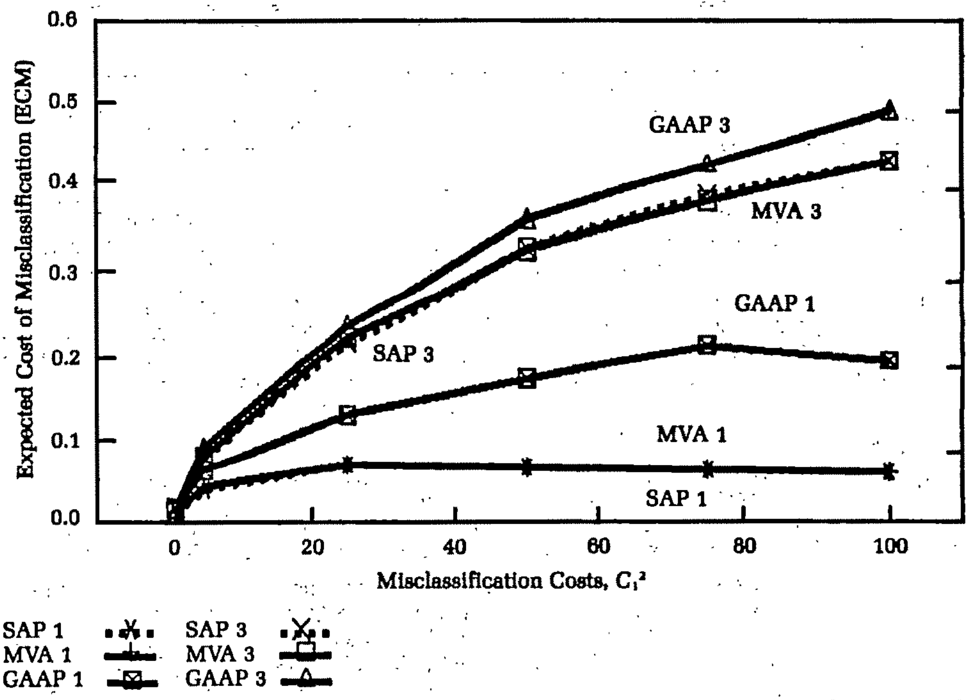
[a] Significant at .01.

[b] Significant at .05.

[*] Insignificant.

itly considering more robust methodology and more comprehensive accounting data. Multivariate logit analyses based on financial indicators that include annual financial ratios as well as multiperiod stability measures are also emphasized. Evidence is provided that SAP and MVA predict insolvency with greater accuracy than GAAP. MVA slightly dominated SAP procedures for several comparisons of classification and prediction, but the differences were often not significant. The hypothesis that different accounting procedures provide similar classification results was rejected in this paper for both estimation and holdout samples one and three years prior to the onset of insolvency. Similar results were obtained when misclassification costs, prior probabilities, and choice-based sample biases were considered. Both MVA and SAP procedures outperform GAAP procedures for all classification and prediction (validation) comparisons.

Figure 1
Expected Cost of Misclassification (ECM)[1]
Obtained by Logit Analysis for Estimation Sample



[1] The expected cost of misclassification, ECM, is equal to $\pi_1 C_1 \times n_1/N_1 + \pi_2 C_2 n_2/N_2$; where n_i = total number of type i misclassifications, N_i = sample size of the ith group, $i = 1, 2$; $C_2 = 1$, $\pi_1 = 0.02$, and $\pi_2 = 0.98$. Type I error is defined as classifying of insurer as solvent when it is insolvent; Type II error is defined as classifying insurer as insolvent when it is solvent.

[2] C_1 is the relative cost of misclassifying an insolvent insurer (Type I error).

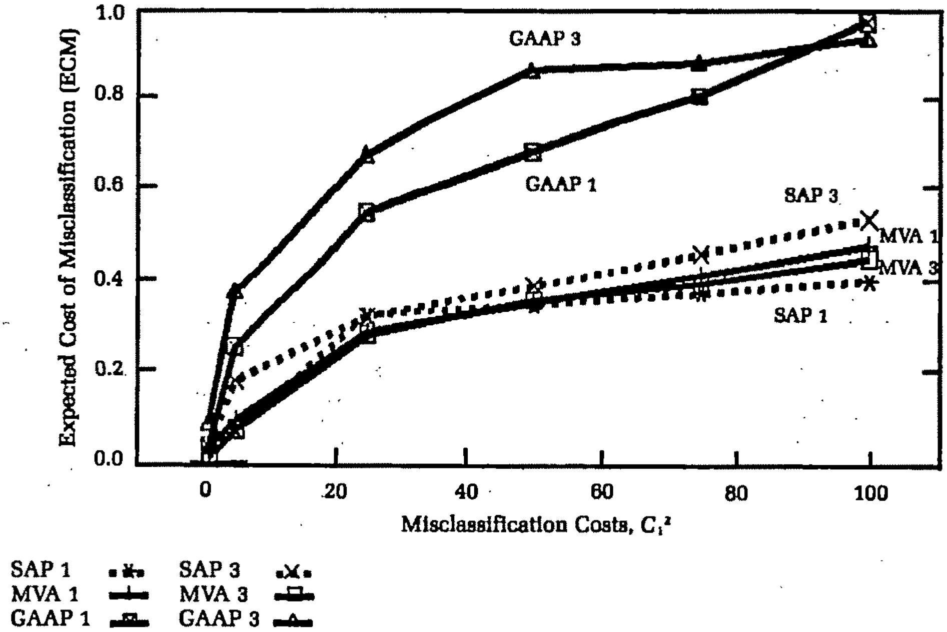
[3] SAP 1—Statutory Accounting Principles, one year prior to insolvency.
GAAP 1—Generally Accepted Accounting Principles, one year prior to insolvency.
MVA 1—Market Value Adjustment and Cash-Flow Measures Procedure, one year prior to insolvency.
SAP 3—Statutory Accounting Principles, three years prior to insolvency.
GAAP 3—Generally Accepted Accounting Principles, three years prior to insolvency.
MVA 3—Market Value Adjustments and Cash-Flow Measures Procedure, three years prior to insolvency.

Appendix

Alternative Accounting Procedures

SFAS No. 60 (FASB 1982), the Audit Guide (AICPA 1982), and the NAIC require insurers in the P&L industry to disclose supplementary data about their properties in schedules, exhibits, and tables. These schedules supply comprehensive earnings numbers, assets, liabilities, and cash flows that are not reported on the SAP balance sheet, income statement, and capital and surplus (equity) account. The SAP figures differ from conventional GAAP in several aspects. Underwriting (acquisition) expenses are not reported *pro rata* over the policy term but are charged immediately when incurred. Related premium revenues defer *pro rata* and, therefore, revenues and expenses are

Figure 2
Expected Cost of Misclassification (ECM)[1]
Obtained by Logit Analysis for Holdout Sample



[1] The expected cost of misclassification, ECM, is equal to $\pi_1 C_1 \times n_1/N_1 + \pi_2 C_2 n_2/N_2$; where n_i = total number of type i misclassifications, N_i = sample size of the ith group, $i = 1, 2$; $C_2 = 1$, $\pi_1 = 0.02$, and $\pi_2 = 0.98$. Type I error is defined as classifying of insurer as solvent when it is insolvent; Type II error is defined as classifying insurer as insolvent when it is solvent.

[2] C_1 is the relative cost of misclassifying an insolvent insurer (Type I error).

SAP 1—Statutory Accounting Principles, one year prior to insolvency.
GAAP 1—Generally Accepted Accounting Principles, one year prior to insolvency.
MVA 1—Market Value Adjustment and Cash-Flow Measures Procedure, one year prior to insolvency.
SAP 3—Statutory Accounting Principles, three years prior to insolvency.
GAAP 3—Generally Accepted Accounting Principles, three years prior to insolvency.
MVA 3—Market Value Adjustments and Cash-Flow Measures Procedure, three years prior to insolvency.

"mismatched." The category of investment earnings encompasses interest income from debt securities and mortgages, dividends from stocks, and all realized and unrealized capital gains (losses) from investment in equity securities (unrealized capital gains are credited or charged directly to equity). Investments in stocks are recorded at market value and investments in bonds at amortized costs. Equipment, furniture, premium, and agent balances more than 90 days due, and several other items are considered as nonadmitted assets and are excluded from the balance sheet. Troxel and Breslin (1983, chaps. 1–4) provide details on these and other SAP measures.

Four sets of insurance company income numbers have been used in the literature for measuring the association of stock prices and market risk levels (Foster 1975, 1977; Kross 1978). These earnings measures include: (1) underwriting earnings; (2) underwriting earnings and investment income; (3) underwriting earnings, investment in-

Exhibit 1

GAAP Income Statement Derived from the Annual Convention Statement

Premium earned
Additions and subtractions

Losses incurred and loss expenses incurred
Acquisition expenses incurred (SAP)
Change in acquisition (underwriting) expenses applicable to unearned premiums[1]
Depreciation of admitted and nonadmitted assets (furniture, equipment, automobiles, and leaseholds)
Net investment income
Net realized gains or losses
Income tax applicable to GAAP[2]

Net income

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[1] Because acquisition cost for every insurance policy based on GAAP information is not available for many P&L insurers in the sample, the prepaid expenses were approximated by multiplying the unearned premium reserve by the ratio of underwriting expenses to net premiums written. This approximation was very close to comprehensive GAAP numbers available for several P&L insurers. A similar accrual-adjusted earning (Moody's formula) has been used by Kross (1978, 477–78) as a linear reversion of the SAP earnings number.

[2] Because comprehensive tax information (e.g., tax paid) was available only for several companies in the sample, all earnings measures in this paper have been recorded before taxes.

Exhibit 2

Net Income—Including Cash Flow Provided by Operations and Unrealized Gains

Insurance premiums received (Part 2 on the annual statement)
Insurance claims and policy holders benefits paid (Parts 3 and 4)
Acquisition (underwriting) expenses paid (Part 4)
Net investment income received (Part 1 on the annual statement)
Net realized gains (losses) from investments (Part 1A)
Other payments received (Exhibit on premium and losses)
Interest paid (Parts 1 and 2)
Income tax paid[1]

Cash provided by operating activities
Additions or subtractions

Unrealized gains (or losses) from investments in equity securities and debt securities
(statement of income, surplus account, and schedule D)
Less allowance for future income tax[1]

Net income (for MVA)

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[1] See footnote 2 in exhibit 1.

Exhibit 3
Recording Transactions According to SAP, MVA, and GAAP

	An Insolvent P&L Insurer (One Year Prior) (Thousands of Dollars)			*A Solvent P&L Insurer (Thousands of Dollars)*		
	SAP	*MVA*	*GAAP*	*SAP*	*MVA*	*GAAP*
Debt Securities[1]	74,006	76,752	75,320	21,556	21,803	21,566
Stock Securities[2]	6,096	6,096	6,096	60,068	60,068	42,836
Other Assets[3]	55,415	55,415	55,415	20,467	20,467	20,467
Nonadmitted Assets	—	1,303	1,303	—	1,194	1,194
Prepaid Underwriting Expenses	—	—	1,126	—	—	12,095
Total Assets	135,517	139,566	139,260	102,091	103,532	98,158
Surplus (Equity)	4,028	8,077	7,771	55,402	56,843	51,469
	Cash Flow			*Cash Flow*		
Underwriting Earnings[4]	(34,501)	(42,388)	(36,798)	(4,126)	(284)	(1,602)
Net Investment Income	9,129	9,019	9,129	2,723	2,827	2,723
Realized Gain	232	232	232	4,356	4,356	4,356
Net Income (Loss) Provided by Operations	(25,140)	—	(27,437)	2,953	—	5,477
Cash Provided by Operations	—	(33,137)	—	—	6,899	—
Unrealized Capital Gain (Loss)	179	2,858	—	7,149	7,445	—
Net Income (Loss) Before Tax	(24,961)	(30,279)	(27,437)	10,102	14,344	5,477

[1] Bonds were recorded at amortized value, market value, and actual (historical) cost for the SAP, MVA, and GAAP, respectively.

[2] Historical cost for stock portfolio was $6.561 million for the insolvent firm.

[3] Data for MVA and GAAP were not available.

[4] Previous years have been included throughout the nine-year calculation for each firm.

come, and all realized capital gains (losses) and unrealized capital gains (losses) from investment in stocks (this measure is employed in accordance with SAP); and (4) surrogate figure numbers according to GAAP, which include underwriting earnings, investment income, and realized capital gains, where underwriting expenses are modified to GAAP. Matching revenues and expenses are thus obtained. In the present study, the third and fourth sets of income are used in accordance with SAP and GAAP, respectively. Underwriting earnings are used in accordance with GAAP for evaluating the GAAP underwriting performance.

Earnings numbers, investments, and nonadmitted assets are also recorded according to GAAP. The liabilities loss reserves are not recorded in accordance with GAAP, however, because the requisite data are not available. Prepaid acquisition expenses and nonadmitted assets (such as furniture and equipment) are added on the GAAP balance sheet. The cost method is used for recording investment in debt securities. The lower-of-cost or market method is applied for investments in equity securities. The major changes in surplus across the accounting procedures are, therefore, due to the use of alternative figure numbers in earnings and assets. Lukens (1974, chap. 16), the Audit Guide (AICPA 1982, chap. 9), and Troxel and Breslin (1983, chap. 1) provide details on reconciliation of the SAP statement in conformity with GAAP. Wygal and Stout (1987) have recently discussed current reporting requirements, proposals, and implementations. The AICPA (1982, 60–61) shows how SAP net income is converted to GAAP.

The GAAP income statement is derived from data available in the annual convention statement (see exhibit 1).

MVA measures the earnings based on cash flow provided by operating (i.e., underwriting and investment) activities. Unrealized capital gains (losses) from investments in stocks (also used in SAP) and unrealized capital gains (losses) from investments in bonds and government securities are also added to cash flows to provide additional earnings measures. All investments in stocks, bonds, and government securities are recorded at market values. The major variables of interest are operating cash flows, and the market value of assets. SFAS No. 95 (FASB 1987) does not address cash-flow reporting issues unique to the P&L industry. However, Ernst & Whinney (1988, 56–61) provide an implementation for insurance companies. In this study, the net income includes cash flow provided by operations and unrealized gains (as shown in exhibit 2). To exemplify how sets of underlying transactions are recorded by the use of SAP, GAAP, and MVA, actual recent data from two sample insurers were recorded (see exhibit 3).

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A FORUM ON
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1. Nabil Elias

   The Effects of Financial Information Symmetry on Conflict Resolution: An Experiment in the Context of Labor Negotiations

   (Submitted: July 1986. Accepted: July 1989.)

2. Peter Chalos and Susan Haka

   Transfer Pricing Under Bilateral Bargaining

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SYNOPSIS: Financial information about an organization is normally more accessible to management than to union negotiators. This article deals with the effects of disclosure of this information to union negotiators on the resolution of industrial conflict. This study differs from previous research in that it (1) defines information symmetry as pre-negotiation knowledge of financial information about the entity in which both negotiators have interests, rather than as direct knowledge of the opponents' payoff, (2) is conducted in a union-management bargaining context, and (3) is concerned with both settlements and conflicts.

As conditions of information symmetry would be difficult to operationalize and control in the field, a laboratory experiment was used to examine the effects of financial information disclosure (symmetry vs. asymmetry) under two conditions of profitability (profit vs. loss) on pre-negotiation expectations and perceptions, and on negotiation outcomes (settlements and conflicts).

In the experiment, a negotiating dyad was formed by assigning one subject a management role and another a union role. In all, 80 subjects forming 40 negotiating dyads participated in the experiment. Profitability took two levels: a profit case or a loss case. Disclosure was manipulated by either providing or withholding historical and forecast financial information

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to union subjects. A pre-negotiation questionnaire solicited perceptions and expectations of subjects. If subjects did not reach a negotiated settlement, their final impasse offers were submitted for arbitration to a hypothetical arbitrator. A post-negotiation questionnaire was then used to obtain subjects' evaluations and perceptions regarding the company, information, settlement, and opponent. Subjects were rewarded according to the level of negotiated or arbitrated settlement.

The results of the experiment generally showed that union subjects' pre-negotiation expectations and conflicts were consistently higher when information was not disclosed to them than in the symmetry case, but expectation differences were statistically significant only in the loss case. As expected, settlements were generally higher in the profit case than in the loss case.

Insignificant differences were obtained in post-negotiation conflicts and settlements between the asymmetry and symmetry treatments, possibly for two reasons. First, indirect disclosures by management subjects during negotiation may have been made. Second, as negotiating parties in the symmetry or asymmetry treatments reached an impasse, they may have moved farther apart in anticipation of an arbitrated settlement.

As settlements and post-negotiation conflicts seemed unaffected by disclosure, an implication of the findings is that unions might benefit by investigating the decision value of the financial information they seek, while management need not automatically assume that information disclosure would make it worse off.

Key Words: *Information Asymmetry-Negotiation, Conflict Resolution, Bargaining, Information in Bargaining.*

Data Availability: *A hard copy of the data is available upon request.*

THE role accounting information plays in labor-management negotiations has become a subject of increasing interest. Research on this subject can be classified as following a normative approach (Cascio 1982; Granof 1973; Lau and Nelson 1981), adopting a macro-economic perspective (Foley and Maunders 1979), using survey methods (Towers and Wright 1983a, 1983b), or applying case research (Amernic 1985, 1989; Jackson-Cox et al. 1984; Moore et al. 1979; Moore and Levie 1981; Owen and Lloyd 1985; Reeves and McGovern 1981). However, with the exception of Liberty and Zimmerman (1986) who examined accounting earnings manipulation in connection with labor contract negotiations, the question of how financial disclosure (information symmetry) affects union-management bargaining has not been explicitly studied.

Since industrial conflicts incur substantial costs (International Labour Office 1987) and affect the competitiveness of organizations, industries, and nations, it is surprising that the effects of information symmetry on labor-management conflict have not been systematically studied. Financial information disclosure to Works Councils (which often include union members) is a highly controversial issue in Europe (CCIP 1986), and has implications in North America and elsewhere. It is often argued that management expects such disclosures to weaken its bargaining position, anticipating more costly settlements (CCIP 1986), but controlled experiments have not been conducted. The purpose of this article is to investigate the effects of financial information symmetry on bargaining behavior and outcome in terms of settlement and conflict.

The study of bargaining behavior is particularly suited to game-theoretic laboratory experiments. Using this approach, several researchers have examined the effects of information symmetry on bargaining behavior in a variety of bargaining settings (Hamner and Harnett 1975; Liebert et al. 1968; Roth and Malouf 1979; Roth and Murnighan 1982; Roth et al. 1988; Schelling 1960; Siegel and Fouraker 1960). However, these studies dealt only with: (1) settings other than union-management bargaining, (2) information symmetry as explicit knowledge by a bargainer of his opponent's payoff rather than as pre-negotiation disclosure of financial information about the entity in which both bargainers have interests, and (3) agreements (settlements) rather than disagreements (conflicts) at the end of negotiation, with some exceptions (e.g., Roth and Murnighan 1982; Roth et al. 1988).

As conditions of information symmetry do not generally exist in labor-management negotiations, and would be extremely difficult to define and control in the field even if present, the research question was studied using a laboratory experiment. The disclosure of financial information to labor negotiators has two levels (information symmetry vs. asymmetry), and the financial health of the entity has two conditions of profitability (profit vs. loss). The effects of both treatments on pre-negotiation expectations and perceptions and on negotiation outcomes (settlements and conflicts) constituted the primary objective of the study. This article reports the results of the experiment and contains the following sections: theoretical development of hypotheses, research method, results, and discussion and conclusions.

I. Theoretical Development of Hypotheses

To simplify investigating the effects of information disclosure to union negotiators on pre-negotiation expectations and negotiation outcomes, the problem is viewed as a two-person game. Asymmetric information would be expected to affect expectations and outcomes differently, depending on whether the withheld information conveys positive or negative signals to each of the negotiators (profit vs. loss).

Roth and Schoumaker (1983) provide evidence that expectations are a major determinant of bargaining strategy. Previous studies also allude to the influence expectations have on negotiation outcomes. In attempting to explain the higher payoffs obtained by the party with less information in games of information symmetry, Schelling (1960), Siegel and Fouraker (1960), and Hamner and Harnett (1975) suggest that the effects of information symmetry or asymmetry on settlements are shaped by expectations. That information asymmetry would increase expectations of the union negotiator is the *information-expectation hypothesis* tested in this article. The hypothesis predicts that average expected settlements by union negotiators would generally be higher in information asymmetry than in information symmetry due to their high expectations in both the profit and loss cases. In the symmetry condition, expectations would depend on the entity's financial health and would be low in the loss case, high in the profit case, provided that union negotiators believe that management is telling the truth in disclosing the profit and loss information.

Schelling's (1960) tacit bargaining argument revolves around converging expectations, a "meeting of the minds." This argument is also implicit in Roth and Malouf (1979) and Roth and Murnighan (1982). Each negotiator has a range of possible solutions which lies between his or her level of aspiration and level of discouragement (Foley and Maunders, 1979). Information symmetry (asymmetry) may enhance (lessen) a meeting of the minds if it leads the negotiators' sets of possible solutions to intersect or converge (diverge). The *information-convergence hypothesis* asserts that information symmetry (asymmetry) enhances (lessens) convergence of *pre*-negotiation ranges of possible solutions, *pre*-negotiation expectations, and *post*-negotiation positions. This hypothesis is indifferent to the profit and loss cases.

In terms of settlements, there are basically two competing hypotheses. Schelling (1960) proposed the *information-weakness hypothesis* to explain the higher average payoff to bargainers with less information about their opponents' stakes. An incompletely informed bargainer would presumably concede more slowly, as he or she is not aware what a reasonable solution is. Consistent results were obtained by Siegel and Fouraker (1960) and Hamner and Harnett (1975). In a labor-management context, the *information-weakness hypothesis* would predict higher (lower) settlements in the information asymmetry (symmetry) case. This result would be more pronounced in the loss case than in the profit case if the union negotiators are unaware of the entity's financial perils.

Perceived-equity, the competing hypothesis, is generally supported in the negotiation literature, though not in the context of information symmetry (Notz and Starke 1987; Schelling 1960). Roth and Malouf (1979) report that agreements between negotiating dyads regarding the distribution of lottery tickets entitling each to a prize draw clustered around a 50-50 split of lottery tickets (equal probability) when neither player knew the size of anticipated prizes. When both players knew the size of unequal anticipated prizes, agreements shifted significantly toward equal expected value outcome. Roth et al. (1988) report on new data that showed significant, predicted effects for prize values on the terms of agreement. These results suggest that bargainers' perception of equity plays a role in shaping an agreement. Because information availability (or lack thereof) and situation (profit or loss) influence perceptions of equity, the perceived-equity hypothesis tested in this article predicts that settlements would be higher in the profit case than in the loss case under the symmetry condition. It also suggests that in the profit case, contrary to the information-weakness hypothesis, information asymmetry (symmetry) would be expected to result in lower (higher) settlements, as perceptions of equity by the union negotiator would be unaffected (affected) by the information. In the loss case, however, as is the case with information-weakness, perceived-equity would predict higher (lower) settlements to be associated with information asymmetry (symmetry), as union negotiators are unaware of the entity's financial perils. Thus, perceived-equity is tantamount to information-advantage in the profit case and information-weakness (disadvantage) in the loss case.

Summary of the Hypotheses

Four testable hypotheses are proposed in this study concerning pre-negotiation expectations (H1), conflict (H2), and settlement (H3 and H4). These hypotheses are stated as follows:

H1: *The information-expectation hypothesis:* Pre-negotiation settlement expectations and perceptions of a fair, good, or poor settlement are higher for union subjects in the information asymmetry treatment than in the information symmetry treatment.

H2: *The information-convergence hypothesis:* Pre-negotiation and post-negotiation conflict (divergence) is higher in the information asymmetry treatment than in the information symmetry treatment.

H3: *The information-weakness hypothesis:* The level of settlements is higher in the information asymmetry treatment than in the information symmetry treatment.

H4: *The perceived-equity hypothesis:* The level of settlements is higher in the profit case than in the loss case. The level of settlements in the information asymmetry treatment is lower (higher) than in the information symmetry treatment in the profit (loss) case.

II. Research Design and Hypotheses

Since each of the two independent variables has two levels—disclosure of financial information to labor negotiators (s=symmetry and a=asymmetry) and profitability of the entity (p=profit and l=loss)—a 2×2 experimental design was used with four treatments: *ps*, *pa*, *ls*, and *la*. Two subjects, one assigned a union negotiator role and another a management negotiator role, formed a negotiating dyad. Subjects were randomly paired, but steps were taken to ensure that any two subjects forming a negotiating pair were unknown to each other. A toss of a coin determined which subject played which role. Dyads were randomly allocated to the four treatments.

All subjects received the same case background material, including information on cost of living, recent wage settlements by other unions, and a five-year summary of company expenditures for improvements in working conditions and employee training. Profitability was manipulated by using (1) a historical exhibit that showed a five-year summary of the company's increasing (decreasing) sales, net income (loss), cash flow (outflow) from operations, and earnings (loss) per share, and (2) a forecast statement that predicted improving (deteriorating) competitive climate, increasing (decreasing) market share, increasing (decreasing) sales, and increasing earnings (loss) per share for the next year. Disclosure was manipulated by providing or withholding the historical exhibit and forecast statement to union negotiator subjects.[1] All management negotiator subjects received the historical exhibit and forecast statement. In all, 80 subjects participated in the experiment, forming 40 dyads. Each of the four cells contained 20 subjects, 10 dyads.

Case

The case used in the experiment and the general approach of conflict creation and negotiation were adapted from Notz and Starke (1978). In the case, the union and management of a department store agreed on all issues of a contract except the average wage increase. The experiment started with management offering a pay increase of one percent and the union asking 11 percent.

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[1] Because unions in publicly traded companies would have access to publicly available historical data, this manipulation represents an extreme form of asymmetry, such as may exist in nonpublicly traded companies.

The Dependent Variables

The dependent variables were operationalized as follows:

1. Pre-negotiation settlement expectations and perceptions were collected for each union and management subject and were based on self-reports. Let a subject's pre-negotiation expectations and perceptions, R, be denoted:

X = expected settlement,
F = perception of a fair settlement,
G = perception of a good settlement (level of aspiration),
P = perception of a poor settlement (level of discouragement), and

let:

u and m denote union and management negotiators, respectively.

2. Pre-negotiation conflict was operationally defined as the distance between union and management subjects' expectations or perceptions. Three measures of pre-negotiation conflict were defined. The first two are measured by the difference in expectations, X, and in perceptions of a fair settlement, F, between a union subject and a corresponding management subject in a negotiating dyad as follows:

(1) conflict in expectations $(C_X) = X_u - X_m$, and
(2) conflict in perceptions of a fair settlement $(C_F) = F_u - F_m$.

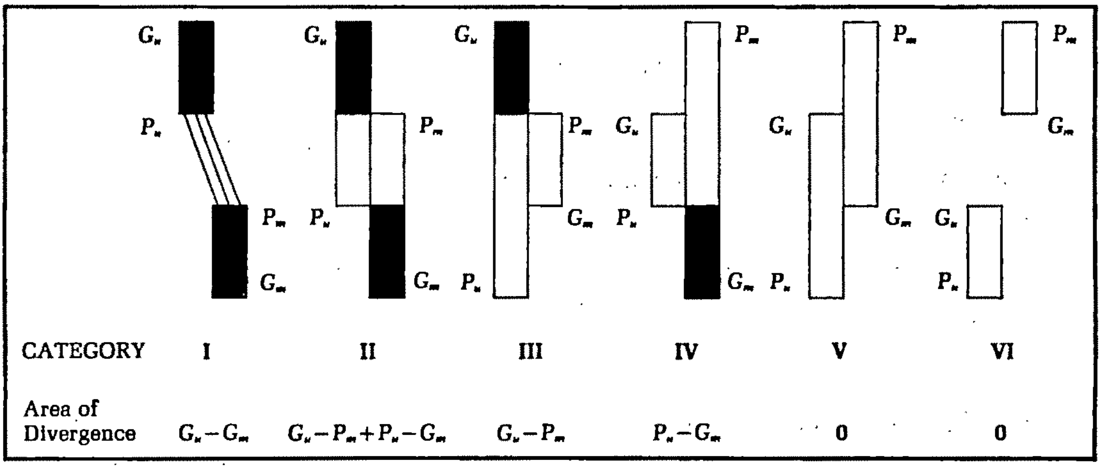
The third definition, divergence, requires further explanation. The range of possible solutions as perceived by each subject can be measured as the difference between what he or she considered to be a poor settlement, P, and a good settlement, G. The range of possible solutions for a negotiating dyad is the area of intersection or convergence in the individual ranges of possible solutions. The pre-negotiation area of divergence is the range of infeasible solutions. The third measure of conflict, divergence (C_D), is thus the range of possibilities outside the intersection. Divergence is measured differently, depending on the conflict posture of a negotiating dyad as illustrated in figure 1. To explain the combinations reported in the figure, negotiating dyads can be classified into six possible conflict categories:

Category I,	where $P_u > P_m$,	$C_D = G_u - G_m$;
Category II,	where $G_u > P_m$ *and* $P_u > G_m$,	$C_D = G_u - P_m + P_u - G_m$;
Category III,	where $G_u > P_m$ *and* $P_u < G_m$,	$C_D = G_u - P_m$;
Category IV,	where $G_u < P_m$ *and* $P_u > G_m$,	$C_D = P_u - G_m$;
Category V,	where $G_u < P_m$ *and* $P_u < G_m$,	$C_D = 0$;
Category VI,	where $G_u < G_m$,	$C_D = 0$.

Note that divergence is in two directions in I and II, in only one direction in III and IV, and nonexistent in V and VI.

3. Post-negotiation conflict was surrogated by the discrepancy, at the end of negotiation, between the two impasse offers submitted separately by the subjects forming a negotiating dyad (Notz and Starke 1978). Let I = an impasse offer by a subject and C_N =

Figure 1
Categories of Pre-Negotiation Divergence Conflict C_D



Legend: u Union
m Management
G Good settlement
P Poor settlement
■ Area of divergence

measure of post-negotiation conflict, then for each dyad, $C_{N1} = I_u - I_m$, excluding dyads that reached a negotiated settlement, and C_{N2} is equal to C_{N1} plus dyads such as those having conflict with a zero value. Both measures had a value range from zero to ten percent.

4. The settlement level: The case used in the experiment provided each pair of negotiators with the two last positions (management's offer of one percent and union's demand of 11 percent) prior to the final negotiation session intended to break the stalemate. Settlements (*W*) were reached either through negotiation (signing a contract) or through arbitration (the midpoint between the two impasse offers as selected by the arbitrator).

Subjects

Subjects were undergraduate students at The University of Manitoba, Canada. A call for participation was posted on bulletin boards and read in classes with which the experimenter was not associated. In a laboratory setting,[2] two subjects at a time formed a negotiating dyad and attempted to negotiate a settlement.

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[2] The weaknesses and strengths of laboratory experiments are discussed elsewhere. For example, see Swieringa and Weick (1982), and Chow (1983, 672). The use of students as subjects has practical advantages in this type of experiment due to set-up, scheduling, and remuneration, and is common in the negotiation literature (e.g., Roth and Malouf 1979; Roth and Murnighan 1982; Notz and Starke 1987). Students have also been used in other behavioral accounting research settings (e.g., Chow 1983; Chow et al. 1988), and the results of student subjects have been compared to business or professional subjects (e.g., Ashton and Ashton 1988).

Pay Scale

Following Notz and Starke (1978), the pay scale used to reward subjects for participation in the experiment was intended to create conflict between labor and management negotiators. At low (high) rates of pay settlement, management subjects would receive higher (lower) awards than union subjects. The pay schedules for union and management moved in the opposite direction, and subjects were not allowed to exchange the information contained therein. These schedules were the same across the experimental treatments.[3]

Task

Subjects were given 20 minutes to read the case and exhibits. Each subject was then asked to fill out a pre-negotiation questionnaire soliciting the subject's pre-negotiation expectations and perceptions. The subjects were allowed to negotiate for 20 minutes. If they reached agreement within 20 minutes, they signed a contract form. If at the end of 20 minutes they had reached an impasse, they then stated their demands, together with a justification of these demands, on an impasse offer form for submission to an arbitrator.

Subjects were not informed how the arbitrated decision would be reached. In an adjacent office a research assistant, not visible to the subjects, acted as the arbitrator and selected the midpoint between the two impasse offers. After being informed of the settlement, subjects filled out a post-negotiation questionnaire, describing their own and their opponent's behavior during negotiation and answering questions that checked the experimental manipulations of profitability and disclosure. Two questions solicited their assessment of profitability and the chances of the company's survival, and a third question asked their views regarding the maximum pay increase (from zero to 11 percent) that the company could afford without risking its long-run survival. To assess the disclosure variable, they were also asked whether they considered the information provided as "adequate" or "inadequate" regarding profitability, competitive and survival factors, and projections and forecasts. Subjects were then paid according to the applicable pay scale.

Tests of Hypotheses

Stated in the alternate form,[4] where E=the mean, a=asymmetry, s=symmetry, p=profit, and l=loss, the hypotheses tested are:

Tests of H1: $E(R_{ax})>E(R_{sx})$, where $R=X, F, G$, or P.
Tests of H2: $E(C_a)>E(C_s)$, where $C=C_X, C_F, C_D$, or C_N.
Tests of H3: $E(W_a)>E(W_s)$, where $W=W, W_p$, or W_l.
Tests of H4: $E(W_p)>E(W_l)$,
$E(W_{ps})>E(W_{pa})$, and
$E(W_{la})>E(W_{ls})$.

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[3] After running a pilot test, the instrument (particularly the pay schedules) was changed to make the expected overall pattern of financial awards for participation in the experiment neutral with respect to the role subjects played (i.e., labor or management). Thus, neither management nor union subjects, by virtue of their role, would consistently have a favorable or an unfavorable treatment.

[4] Although all hypotheses are directional, hypotheses H3 and H4 are competing hypotheses in the profit case. For consistency, probabilities using two-tailed t- and chi-squared (with continuity correction) tests are reported throughout the paper, which is conservative in testing directional hypotheses.

III. Results

Manipulation Checks

Manipulation checks were performed for profitability and disclosure. The profitability check was performed for all subjects who were provided with pre-negotiation financial information, i.e., all management subjects and union subjects in the symmetry treatment. Responses to the three questions assessing profitability by all management and those union subjects in the symmetry treatment differed between the profit case and the loss case, and such differences were statistically significant (one-way ANOVA for each of these factors, $p<0.0001$).

The disclosure manipulation check was applicable only to union subjects. In responding to whether they considered they had adequate or inadequate information related to profitability and cash flow, competitive and survival factors, and projections and forecasts, union subjects in the information asymmetry treatment more frequently considered such information inadequate compared to their counterparts in the symmetry treatment, and these differences were statistically significant (chi-squared test, $p<0.0000$, $p<0.0099$, and $p<0.001$, respectively). As these questions were part of the post-negotiation questionnaire, any disclosures by management subjects to union subjects in the asymmetry treatment during negotiation would result in union subjects' responses capturing only a partial effect of the disclosure manipulation.

Table 1 provides summary statistics contrasting union and management pre-negotiation perceptions, expectations, opening offers, and impasse offers as a general check on conflict creation in the laboratory.

Experimental Results

Hypothesis H1 required analysis of union negotiators' behavior, while hypotheses H2, H3, and H4 required analysis of dyadic behavior.

Table 2 shows results consistent with hypothesis H1, the information-expectation hypothesis. Union subjects' mean expectations $E(X)$, aspiration levels $E(G)$, discouragement levels $E(P)$, and perceptions of a fair settlement $E(F)$, were consistently lower in the information symmetry than in the information asymmetry treatment. Such differences were statistically significant for the entire sample of union subjects (t-test, $p<0.05$ for the means of X, F, and G, and $p<0.10$ for P) and for union subjects in the loss case ($p<0.05$ for the means of E and G; and $p<0.10$ for F) except for discouragement level P. The differences were not statistically significant in the profit case alone.

The relatively high expectations of union subjects in the information asymmetry treatment were coupled with greater optimism. On average, they were more optimistic than management subjects about reaching a negotiated settlement (mean subjective probability: union, 0.67 vs. management, 0.49; mean difference is significant at $p=0.005$) and were also more optimistic than their counterparts in the symmetry treatment (asymmetry, 0.67 vs. symmetry, 0.51; mean difference is significant at $p=0.012$).

Table 3 shows the results of testing hypothesis H2, the information-convergence hypothesis. Pre-negotiation conflict as measured by mean differences in expected settlements, "C_X," mean differences in perceptions of a fair settlement, "C_F," or mean area of no intersection between perceived ranges of possible solution (or divergence), "C_D," were consistently lower in the information symmetry treatment than in the information asymmetry treatment. These differences were statistically significant for the entire

Table 1

Comparison of Union-Management Pre-Negotiation and Post-Negotiation Variable Means

	Asymmetry			*Symmetry*		
	Union n=10**	*Management* n=10**	p=	*Union* n=10*	*Management* n=10*	p=
Panel A. The Loss Case:						
Pre-Negotiation Perceptions						
Good Settlement *G* (0% to 11%)	9.05	2.80	0.000	7.45	2.90	0.000
Poor Settlement *P* (0% to 11%)	3.96	7.25	0.010	3.10	7.25	0.001
Fair Settlement *F* (0% to 11%)	7.65	3.34	0.000	6.30	3.78	0.001
Expected Settlement *X* (0% to 11%)	8.05	3.65	0.000	6.35	3.67	0.001
Expected Chance of Agreement (0.1 to 1.0)	0.72	0.52	0.046	0.52	0.45	0.379
Importance of Avoiding Arbitration (1 to 9)	6.80	6.80	1.000	7.30	6.40	0.163
Importance of Strong Self-Presentation (1 to 9)	8.20	8.10	0.844	7.80	7.50	0.544
Post-Negotiation Results						
Satisfaction with Negotiations	4.20	4.30	0.936	3.60	4.30	0.546
Opening Offer (% increase)	11.55	1.25	0.000	11.20	1.10	0.000
Impasse Offer (% increase)	7.69**	2.89**	0.000	7.51*	2.83*	0.000

Table 1—*Continued*

	Asymmetry			*Symmetry*		
	Union $n=10$	*Management* $n=10$	$p=$	*Union* $n=10$	*Management* $n=10$	$p=$
Panel B. The Profit Case:						
Pre-Negotiation Perceptions						
Good Settlement G (0% to 11%)	9.70	3.05	0.000	8.90	3.30	0.000
Poor Settlement P (0% to 11%)	5.20	5.50	0.830	3.70	6.40	0.062
Fair Settlement F (0% to 11%)	8.55	3.36	0.000	7.65	4.31	0.000
Expected Settlement X (0% to 11%)	7.85	3.46	0.000	7.45	4.34	0.000
Expected Chance of Agreement (0.1 to 1.0)	0.61	0.46	0.053	0.50	0.44	0.523
Importance of Avoiding Arbitration (1 to 9)	6.90	5.50	0.152	7.00	6.30	0.462
Importance of Strong Self-Presentation (1 to 9)	7.50	7.70	0.736	7.30	7.50	0.769
Post-Negotiation Results						
Satisfaction with Negotiations	3.50	4.70	0.161	5.60	3.60	0.004
Opening Offer (% increase)	10.50	1.48	0.000	10.70	2.25	0.000
Impasse Offer (% increase)	8.55	3.15	0.000	8.55	4.06	0.000

* Except where an asterisk appears in cell, $n=9$.

** Except where two asterisks appear in cell, $n=8$.

Table 2
Pre-Negotiation Expectations and Perceptions—Union Subjects (H1) The Information-Expectation Hypothesis

	Mean Settlement				
	Symmetry		*Asymmetry*		*Probability of t*
	Mean	n	*Mean*	n	
Pre-Negotiation Variables:					
Expected Settlement "X"					
Profit Case	7.45	10	7.85	10	0.575
Loss Case	6.35	10	8.05	10	0.031
Combined	6.90	20	7.95	20	0.045
Fair Settlement "F"					
Profit Case	7.65	10	8.55	10	0.208
Loss Case	6.30	10	7.65	10	0.076
Combined	6.98	20	8.10	20	0.036
Good Settlement (Aspiration Level) "G"					
Profit Case	8.90	10	9.70	10	0.216
Loss Case	7.45	10	9.05	10	0.008
Combined	8.18	20	9.38	20	0.010
Poor Settlement (Discouragement/Resistance Level) "P"					
Profit Case	3.70	10	5.20	10	0.124
Loss Case	3.10	10	3.96	10	0.394
Combined	3.40	20	4.58	20	0.090

Tests of H1: $E(X_{ai}) > E(X_{si})$ Supported.
$E(F_{ai}) > E(F_{si})$ Supported.
$E(G_{ai}) > E(G_{si})$ Supported.
$E(P_{ai}) > E(P_{si})$ Weak Support.

sample ($p < 0.05$ for the means of C_X and C_F, and $p < 0.10$ for C_D). The differences in the profit and loss cases were also significant ($p < 0.10$) except for two measures: C_D in the loss case and C_X in the profit case. However, post-negotiation conflict C_N as measured by the mean differences in impasse offers excluding agreements or including agreements were not statistically significant (see table 3).

In addition to tests of magnitude, table 4 shows a cross-tabulation of dyads by conflict category and information symmetry treatment. Categories I and II can be said to have greater divergence (i.e., divergence on both sides), while Categories III and IV show lesser divergence (divergence on only one side), and Category V shows no divergence. Of 17 high conflict dyads (types I and II), 12 negotiated under conditions of information asymmetry, while 15 of the 23 low conflict dyads (types III, IV, and V) negotiated under conditions of information symmetry. As can be expected, no dyads fell in Category VI. A chi-squared test was applied, and this result, which is consistent with the information-convergence hypothesis, was statistically significant ($p = 0.055$).

In terms of the effects of information symmetry on settlements, the mean settlement in the profit case was higher in the symmetry treatment than in the asymmetry treatment, i.e., in the direction predicted by perceived equity (H4) and not information weakness (H3). However, such difference was not statistically significant (see table 5,

Table 3
Dyadic Analysis
Pre-Negotiation Conflict, Post-Negotiation Conflict by Information Symmetry
(H2) The Information-Convergence Hypothesis

	Mean Discrepancy				
	Symmetry		*Asymmetry*		
	Mean	n	*Mean*	n	*Probability of t*
Pre-Negotiation Conflict:					
Difference in Expected Settlement "C_X"					
Profit Case	2.94	10	4.44	10	0.141
Loss Case	2.50	10	4.40	10	0.095
Combined	2.72	20	4.42	20	0.022
Difference in Perceptions of a Fair Settlement "C_F"					
Profit Case	3.39	10	5.19	10	0.058
Loss Case	2.53	10	4.31	10	0.085
Combined	2.96	20	4.75	20	0.010
Divergence (area of no intersection) "C_D"					
Profit Case	3.05	10	5.45	10	0.069
Loss Case	2.05	10	3.16	10	0.396
Combined	2.55	20	4.31	20	0.059
Post-Negotiation Conflict:					
Difference in Impasse Offers "C_{N1}" Excluding Agreements					
Profit Case	4.49	10	5.40	10	0.400
Loss Case	4.68	9	4.80	8	0.919
Combined	4.58	19	5.13	18	0.474
Difference in Impasse Offers "C_{N2}" Including Agreements					
Profit Case	4.49	10	5.40	10	0.400
Loss Case	4.21	10	3.84	10	0.773
Combined	4.35	20	4.62	20	0.745

Tests of H2: $E(C_{Xa}) > E(C_{Xs})$ Supported.
$E(C_{Fa}) > E(C_{Fs})$ Supported.
$E(C_{Da}) > E(C_{Ds})$ Supported.
$E(C_{N1a}) > E(C_{N1s})$ Not Supported.
$E(C_{N2a}) > E(C_{N2s})$ Not Supported.

panel A). The mean settlement was essentially the same in the loss case for the symmetry and asymmetry treatments, which was not in conformity with either hypotheses H3 or H4. The mean settlement, however, was higher in the profit case than in the loss case, as would be expected under hypothesis H4, the perceived-equity hypothesis (table 5, panel B), and these differences were statistically significant for the entire sample and for the information symmetry treatment (at $p < 0.05$), but were not significant in the information asymmetry treatment alone.

To capture the effects of information symmetry on the dynamics of negotiation, an analysis was performed of each negotiator's self-perception and perceptions of the opponent's behavior during negotiations in terms of being honest, friendly, tough, demanding, emotional, cooperative, and yielding. Generally, union and management sub-

Table 4
Dyadic Analysis
Frequencies of Type of Pre-Negotiation Divergence by Information Symmetry
(H2) The Information-Convergence Hypothesis

	Symmetry	*Asymmetry*	*Total*	
	Frequency of Dyads	*Frequency of Dyads*	*Frequency of Dyads*	*Probability of Chi-Square*
Type of Divergence:				
High (Categories I, II)	5	12	17	
Low (Categories III, IV, V)	15	8	23	
Total	20	20	40	0.055

Further analysis of H2: Frequencies of dyads in C_D categories:
Frequency in high C_{Ds} < Frequency in high C_{Da}
Frequency in low C_{Ds} > Frequency in low C_{Da}

Table 5
Dyadic Analysis
Mean Settlement by Information Symmetry and Profitability
(H3) The Information-Weakness and (H4) Perceived Equity Hypotheses

Settlements: (Arbitrated or Negotiated)
Panel A.

	Mean Settlement				
	Symmetry		*Asymmetry*		
	Mean	n	*Mean*	n	*Probability of t*
Profit Case	6.30	10	5.83	10	0.114
Loss Case	5.18	10	5.25	10	0.886
Combined	5.74	20	5.54	20	0.538

Panel B.

	Mean Settlement				
	Profit		*Loss*		
	Mean	n	*Mean*	n	*Probability of t*
Symmetry	6.30	10	5.18	10	0.028
Asymmetry	5.83	10	5.25	10	0.125
Total	6.06	20	5.21	20	0.007

Tests of H3: $E(W_a) > E(W_s)$ Not supported.
$E(W_{pa}) > E(W_{ps})$ Not supported.
$E(W_{la}) > E(W_{ls})$ Not supported.

Tests of H4: $E(W_p) > E(W_l)$ Supported.
$E(W_{ps}) > E(W_{ls})$ Not supported.
$E(W_{pa}) > E(W_{la})$ Not supported.

Table 6
Profit/Loss Information Provided by Management as Indicated by Union Subjects

Information Provided by Management	*Frequencies*			*Probability of Chi-Square*
	Symmetry	*Asymmetry*	*Total*	
Profit Case				
Information provided	0	3	3	
Information not provided	10	6	16	0.174
	10	9	19	
Loss Case				
Information provided	2	8	10	
Information not provided	8	2	10	0.025
	10	10	20	
Combined				
Information provided	2	11	13	
Information not provided	18	8	26	0.005
	20	19	39	

jects' perceptions of their opponent's behavior in the profit case and in the loss case were not different, whether in the symmetry or asymmetry treatment. However, in terms of self-perception, union (management) subjects in the symmetry treatment in the profit case saw themselves as more (less) tough, more (less) demanding, and more (less) unyielding ($p=0.023$, $p=0.010$, and $p=0.036$, respectively), but not so in the loss case. In the profit case of the information asymmetry treatment, the self-perception of union and management subjects was not different except that management (union) subjects reported lower (higher) self-perception of honesty during negotiations ($p=0.003$). Holding back (or possible misrepresentation of) good news appears to have made management subjects perceive themselves as less honest than did union subjects in the profit-asymmetry treatment. However, holding back or communicating bad news, as in the loss-asymmetry treatment, did not lead to the same differences in perception.

An attempt was made to determine items of information disclosed and the timing of disclosure during the process of negotiation in the asymmetry treatment from the taped negotiation sessions. No clear patterns emerged. Responses to questions in the post-negotiation questionnaire regarding the sources of information, however, indicated that more union subjects in the asymmetry treatment obtained information about profitability from management subjects during negotiation than in the symmetry treatment, or so they perceived. As table 6 shows, this result was more pronounced in the loss case than in the profit case. No assessment of information misrepresentation in the profit case could be made.

Further analysis indicated that union subjects, on average, had greater downward adjustments from pre-negotiation expectations to impasse offers in the asymmetry

Table 7
Change in Pre-Negotiation Expectations—Union Subjects

Change to Final Position	Mean (Downward) Adjustment: Symmetry	Mean (Downward) Adjustment: Asymmetry	Probability of t
Expected Settlement Less Impasse Offer			
Profit Case	−1.10	−0.70	0.686
Loss Case	−0.91	+0.90	0.018
Combined	−1.01	+0.10	0.078

Profit case: $E(X_{pua}-I_{pua})>E(X_{pus}-I_{pus})$ Not supported.
Loss case: $E(X_{lua}-I_{lua})>E(X_{lus}-I_{lus})$ Supported.

treatment than in the symmetry treatment (i.e., $E(X_{ua}-I_{ua})>E(X_{us}-I_{us})$. Such differences were relatively large (small) and statistically significant (not significant) in the loss (profit) case (table 7). This further supports the suggestion that the process of negotiation may have involved more disclosures by management subjects in the loss case than in the profit case.

In summary, the results of hypotheses testing are as follows:

H1: The information-expectation hypothesis was supported generally, but was more pronounced in the loss case. In the profit case alone, the results were not statistically significant.
H2: The information-convergence hypothesis was generally supported regarding pre-negotiation conflict, but not in terms of post-negotiation conflict.
H3: The information-weakness hypothesis was not supported.
H4: The perceived-equity hypothesis was supported only to the extent that higher settlements resulted in the profit case compared to the loss case in the symmetry condition. However, it was not supported in terms of the effects of information symmetry/asymmetry on settlements.

IV. Discussion and Conclusions

Information asymmetry generally resulted in initial higher expectations and greater optimism on the part of union subjects, and higher divergence than in the symmetry treatment. At the same time, information symmetry did not result in higher settlements or lower post-negotiation conflict than the asymmetry treatment. Post-negotiation conflicts and settlements were determined, for the most part, by impasse offers, as arbitrated settlements were reached in 37 out of 40 dyads. Impasse offers were unaffected by information disclosure. This means that in the asymmetry treatment, the relatively high pre-negotiation expectations were subsequently lowered by greater downward adjustments during negotiations than in the symmetry treatment. Such adjustments can be explained in two ways. They could be attributed to the communication of information by management, information-trickle, during negotiations, or they could be attributed to the limited role financial information plays in shaping impasse offers. It is possible that once an impasse is reached, subjects become more concerned with the arbitration outcome in determining their impasse offers. In this experiment, financial information disclosure did not affect arbitrated settlements. The sample of negotiated settlements was too small (three dyads) to reach any conclusions on such settlements.

This study attempted to examine the effects of positive or negative information (profit vs. loss). Although settlements were affected by profit/loss in the symmetry treatment, they were unaffected by financial information disclosure for either the profit or the loss case. Thus, neither the information-weakness hypothesis nor the perceived-equity hypothesis was supported. The information-expectation hypothesis applied more in the loss case than in the profit case. In the profit case, however, this effect seems to result from high expectations of union subjects in the asymmetry treatment due to lack of information, compared to the somewhat lower but still relatively high expectations, due to the positive nature of information, in the symmetry treatment.

Several issues require further investigation. For example, this study treated negotiations as a one-period game. Future research may verify the extent to which the conclusions of this study apply in a multi-period setting. The willingness of management to disclose financial information truthfully is another dimension of future research (Liberty and Zimmerman 1986). Since historical information for publicly traded companies is publicly available, it would be interesting to examine the effects of manipulating forecast information only (Elias and Ezzamel 1990). As this study was based on the existence of a conventional arbitration mechanism, an interesting extension of this research might be to examine the effects of information symmetry under alternative arbitration mechanisms, such as negotiating under a final offer (Elias and Ezzamel 1990) or a double final offer clause, or having no arbitration. Future research may also examine the effects of information symmetry with a focus on organizational culture, personality variables, bargaining on behalf of a constituency, triad bargaining and coalition formation, different cultural settings, or different labor market conditions. Factors such as the effect of information symmetry on integrative bargaining and attitude restructuring merit future research.

This experiment concentrated on financial negotiations for higher wages, but union demands for greater disclosure may be aimed at improving working conditions, obtaining representation on boards of directors, obtaining stock ownership, exercising power, controlling a company's future, or coping with uncertainty. Information symmetry may be seen not only as a *need* but also as a *right*. This study did not consider this political aspect of information.

If the results of this experiment lead to any practical conclusion for unions or management, it is that unions need to investigate the decision value of the information they seek, and management need not automatically assume that disclosures would make it worse off.

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Transfer Pricing Under Bilateral Bargaining

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SYNOPSIS: Negotiation is frequently advocated as a transfer-pricing mechanism in decentralized organizations to foster greater divisional autonomy and to improve firm profit performance. Empirical evidence reveals that many firms rely upon negotiation in determining transfer prices. A concern, however, is that negotiation may not always be efficient in terms of maximizing firmwide profits, or equitable with regard to divisional performance evaluation. Given external market opportunities and private information with respect to divisional cost and revenue functions, one division could conceivably make itself better off at the expense of another or the firm as a whole.

This study used a bilateral bargaining methodology to examine negotiated transfer-pricing outcomes between a buying and selling division. The negotiation was nonzero sum; that is, market externalities existed. Each division had private profit information. One hundred and thirty-four subjects participated in face-to-face negotiations. Experimental manipulation included a mixed-incentive (company and divisional) scheme versus a divisional-incentive scheme; single-period versus multiperiod negotiations; and varying levels of market price uncertainty in the negotiations. It was hypothesized that divisional-incentive schemes would increase profit differences between divisions but would be more effective in terms of maximizing overall company profits. Absent learning effects, a negotiation history was expected to increase company profits as bargaining strategies evolved over time. Finally, divisional profit differences were hypothesized to increase in the face of uncertain market alternatives available to either the buying or selling division.

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The results indicate that divisional incentives did not produce greater divisional profit differences than mixed incentives. However, as hypothesized, uncertain outside market alternatives significantly increased divisional profit differences. Company profits increased significantly under divisional incentives and through time. Finally, single-period profits were significantly lower than final multiperiod profits.

The results have potentially important implications for research on negotiated transfer pricing under decentralization. First, divisional profit-based incentives appear to motivate negotiators to achieve higher company profits regardless of outside market alternatives. Bargaining strategies evolved over time, leading to an increase in company profits. Negotiated transfer prices, however, do not always attain the desired objective of maximizing companies' profits or providing equitable divisional performance evaluation. This was particularly true in cases of short negotiation histories and in cases of uncertain market environments. Results of this study suggest that one way to mitigate these dysfunctional consequences is through the company's incentive system. Mixed (company and divisional) incentives in uncertain environments appear to lead to more integrative agreements, benefiting both the company and the division. Because these results are based upon analysis of experiments, caution must be exercised in generalizing the conclusions beyond this setting.

Key Words: *Transfer Pricing, Bilateral Bargaining.*

Data Availability: *Data is available from the authors upon request.*

AN unresolved issue in negotiated transfer pricing in decentralized organizations is ensuring firm profit maximization while fostering divisional autonomy. Although motivational benefits to decentralization are generally acknowledged, market externalities and divisional gaming may significantly mitigate these alleged advantages. To date, no empirical studies have investigated the behavioral issues associated with negotiated transfer pricing despite repeated calls for such research (Abdel-khalik and Lusk 1974; Watson and Baumler 1975; Thomas 1980; Grabski 1985). In this study, we examined factors contributing to possible divisional inequities and suboptimal company profits with negotiated transfer pricing in decentralized environments and investigated incentive schemes that might mitigate these deficiencies.

Private information, divergent payoff preferences between divisions, and market externalities are problematic in a decentralized setting. As a result, truth-inducing centralized schemes have been proposed (Harris et al. 1982; Amershi and Cheng 1987). Although these analytical centralized schemes indicate that the principal (company) can extract all benefits from the agent's (division's) private information, these schemes leave unresolved the issues of divisional information, divisional autonomy, and performance evaluation (Tang 1979; Vancil 1979).

Decentralized negotiations have been suggested as a means of arriving at a transfer price that achieves goal congruence for the firm and that can be used to motivate and evaluate divisional performance (Watson and Baumler 1975; Kaplan 1982). Empirical evidence indicates that a significant number of firms use a negotiated transfer-pricing mechanism (Tang 1979; Wu and Sharp 1979). Purported advantages of negotiation include enhanced divisional autonomy, more cost-effective information gathering at local levels, and improved performance evaluation. Limited empirical evidence suggests that as environmental uncertainty increases, interdepartmental conflict is best resolved through negotiation (Lawrence and Lorsch 1967; Ackelsberg and Yukl 1979).

One of the concomitant disadvantages associated with negotiated transfer prices is that negotiated profit allocations may be a function of relative bargaining ability rather than economic contribution (Dopuch and Drake 1964; Abdel-khalik and Lusk 1974). Survey evidence on the bargaining ability issue (Lambert 1979) shows a higher level of perceived conflict with negotiated as compared with cost- or market-based transfer pricing. It is also argued that when market alternatives are available to one but not both divisions, firmwide profit maximization may not be attainable (Thomas 1980). These concerns raise questions about the justification for negotiated transfer pricing.

In this experiment, we examined the effects of bilateral market monopoly and negotiation history upon both divisional and company profits and considered the effect of divisional- and firmwide-incentive schemes under differing degrees of market uncertainty. It appears that firmwide-incentive schemes are most beneficial when negotiating transfer prices in uncertain markets after only a short history of negotiation. However, in more predictable markets and longer bargaining histories, divisional incentives are preferable to mixed (divisional and company) incentives. No normative conclusions, however, are drawn with respect to circumstances under which negotiation mechanisms should be implemented.

I. Motivation and Hypotheses

Williamson's (1975, 1979) analysis of alternative methods of organizing economic exchange provides a useful frame of reference for identifying environmental uncertainty and moral hazard, phenomena frequently found in negotiated transfer-pricing environments. Cost and production information, for example, is private to divisions, and market uncertainty often exists about the intermediate product under negotiation. The design of the manager's incentive scheme may further serve to change transaction costs. The relationship between negotiated transfer pricing and incentive schemes, market uncertainty, and negotiation history developed in the extant literature are summarized below.

Incentive Scheme

Williamson's (1979) work demonstrates that transaction costs are affected by the design of the manager's incentive scheme. Previous transfer-pricing research has also shown that incentive schemes (Lambert 1979; Ackelsberg and Yukl 1979; Eccles 1983; Spicer 1988) are crucial for promoting divisional equity, minimizing transaction costs, and maximizing firm profit. Using data from extensive field work, Eccles (1985) defined transfer-pricing incentives along a continuum of divisional and corporate schemes. At one extreme, divisional schemes emphasize a process of distributive bargaining in which profit centers seek to maximize their own results even if at the expense of other profit centers. This led Eccles (1985, 191) to hypothesize that "the greater the emphasis on individual profit center results ... the higher the level of conflict (when market-based transfer prices are used)." An earlier survey by Lambert (1979) corroborates an increase in perceived divisional conflict by managers when transfer prices are based solely on divisional profits.

At the other extreme from division-based incentives are purely corporate schemes in which rewards are based on joint outcomes. An argument in favor of such schemes is that divisions are encouraged to adopt a win-win strategy, which increases divisional equity. As summarized by Spicer (1988, 317), "To the extent that rewards of divisional managers are tied to joint (firm) profits, the greater will be the incentive for division managers to cooperate." While the above suggests that divisional incentives might be more dysfunctional than corporate schemes because of promoting divisional inequities, such conflict may well be beneficial from the company's point of view.

Ackelsberg and Yukl (1979) found more cooperative behavior when subjects' rewards were based on corporate profits. However, they were unable to demonstrate superior company profits from corporate-based rewards. In addition, support for firm profit maximization under competitive incentive schemes exists in the bargaining literature. Elevated bargainer aspiration levels, which coincide with higher expected payoff, do lead to higher bargainer profits (Siegel and Fouraker 1960; Kahan 1968). Pruitt and Lewis (1975) found that bargainers with high motivation for self-interested behavior are more likely to find optimal bargaining solutions than are subjects with lower aspiration levels. More recently, Huber and Neale (1987) found that dyadic performance increased when both negotiators had moderately difficult goals.

As this review suggests, the extant literature posits greater divisional inequities under divisional incentives but superior company profits. Accordingly, the following two hypotheses were examined:

H_{1a}: Divisional inequities, measured by divisional profit differences, will be significantly higher under a divisional-incentive scheme than under a mixed- (divisional and company) incentive scheme.

H_{1b}: Company profits will be significantly higher under a divisional-incentive scheme than under a mixed- (divisional and company) incentive scheme.

Market Uncertainty

Williamson (1979) argues that environmental uncertainty surrounding a transaction is a key factor dictating an internal or external purchase of an intermediate good. Similarly, Watson and Baumler (1975) conclude that coping with uncertainty is the central problem facing organizations when determining transfer-pricing policies. The greater the environmental (and technical) uncertainty, the greater the pressure to decentralize in order to cope with the uncertainty. Watson and Baumler (1975, 471) conclude that negotiation is "the most important means of resolving interdepartmental conflict arising through uncertainty." Spicer (1988, 317) holds a different opinion. He hypothesizes that conflict will escalate in negotiated settings as environmental uncertainty increases, a problem that can be compounded with divisional-based incentive schemes:

> The greater . . . the degree of uncertainty and/or complexity associated with the intrafirm transactions, the more likely it is that the firm will de-emphasize performance measurement and incentive mechanisms that focus entirely on divisional profitability, in favor of broader measures and incentives that recognize the need for cooperation.

Although no empirical accounting research has addressed the role of market uncertainty upon transfer pricing, bargaining studies indicate the possibility of such effects. In a series of classic bilateral bargaining experiments, Fouraker and Siegel (1963) concluded that under certain bilateral bargaining conditions, contracts tended to be Pareto optimal and to involve an equal partitioning of the maximum joint profits. However, when bargaining conditions changed to power relationships that became asymmetrical due to uncertainties, agreements were not Pareto optimal under most experimental conditions. This leads to the following two hypotheses:

H_{2a}: Uncertain market opportunities will significantly increase divisional profit differences.

H_{2b}: Divisional profit differences will be significantly higher when market uncertainties are high *and* managers are rewarded based solely on divisional profits.

Negotiation History

Williamson (1979) speculates that transaction frequency has a significant impact on internal versus external buying behavior. Long-term relationships prevent competition over short-term results from becoming detrimental to long-term performance. Previous transfer-pricing research has assumed either a one-period horizon or temporal stability (Hirshleifer 1956; Enzer 1975; Burton et al. 1974). However, introducing multiperiod effects implies that negotiators can become familiar with their partners' strategies.

In a single-period negotiation, reciprocity does not apply. Therefore, the incentive is to capture as much of the available payoff as possible, regardless of the impact on the negotiating partner. In multiperiod settings, this type of opportunistic behavior may lead to an unprofitable strategy (Axelrod 1984). If a negotiator takes advantage of some uncertainty, the disadvantaged negotiating partner often behaves opportunistically in later negotiations. Rapoport and Chammah (1965) and Voissem and Sistrunk (1971) found that cooperative behavior in Prisoner's Dilemma games evolved as a direct function of time. In these experiments, exploitative behavior was retaliated against in a "tit-for-tat" strategy, leading to the evolution of cooperative behavior. Axelrod (1984) created an extended computer tournament based on multiperiod Prisoner's Dilemma games. A "tit-for-tat" or reciprocal strategy provided optimal payoffs against highly complicated expert strategies. A transfer-pricing study by DeJong et al. (1989) found that under very severely restrictive laboratory conditions, direct negotiations became more efficient in terms of maximizing firm profits over time.

The foregoing results suggest that in a negotiated setting, firm profits may increase over time and can be significantly influenced by the duration of the negotiation. Thus, the following hypotheses are posited:

H_{3a}: Firm profits will be significantly larger in the final multiperiod session than in the single-period negotiation session.

H_{3b}: Firm profits will increase significantly during the multiperiod negotiation.

II. Experimental Method

Procedures

One hundred and thirty-four senior level accounting and MBA student volunteers were enlisted to participate in the experiment. They were randomly paired and divided equally across all incentive and market conditions. Test instruments pertaining to each treatment condition were administered to subjects. Explanations were given with particular emphasis on the divisional profit schedule, market alternatives where applicable, and the incentive schemes. Examples from an unrelated profit matrix of possible agreements and their payoff outcomes were also provided. Negotiators were given 20 minutes per session in face-to-face negotiations to reach an agreement. After 20 minutes, the terms of the agreement were noted. Negotiations were repeated over three rounds for the multiperiod negotiation and one round for the single-period negotiation in the manner described in the following sections.[1]

Bilateral Bargaining Task

The experiment was modeled as a repeated two-person variable-sum game with incomplete information (Pruitt 1981; Bazerman et al. 1985). It was designed as nonzero sum to realistically depict market externalities that would be expected to make at least one division better off. The experiment was designed as one of incomplete information (see Hoggatt et al. 1978) because transfer pricing in a decentralized environment involves *ex ante* divisional information asymmetries with respect to cost structure.

The transfer-pricing literature suggests that efficiency and equity are of primary importance in decentralized negotiation. A coordinative equilibrium-bargaining strategy between divisions could meet these goals by maximizing company profit and promoting divisional equity. Accordingly, the dependent variables of interest were (1) firm profits, defined as the sum of divisional profits, and (2) divisional profit differences. Divisional inequity was measured by the difference between the negotiating divisions' profits, assuming that other effects such as different divisional investment or relative riskiness of the investment were held constant.

The experiment simulated a vertically integrated firm in which a supplying division, operating in an imperfect market, provided components to a buying division for further assembly and resale in a final market. Under imperfect competition, transfer pricing by the seller at market could lead to suboptimal output and nonmarket clearing prices for the buyer, who is typically a price-taker in the final market (facing a downward-sloping demand curve). In such situations, the majority of decentralized firms rely on negotiation in conjunction with market prices to moderate market functions (Eccles 1985).

For purposes of experimental manipulation, the effect of various price/quantity combinations upon each division's profits was summarized in a matrix. Each cell reflected the effects of the net revenue function upon both the buying and selling divisions for various negotiated price/quantity combinations. Each division manager had private information which consisted of a profit schedule matrix (exhibit 1). The matrix columns represent three subcomponents required by the buying division for an outside contract. The rows represent the divisional profit for various possible price and quantity agreements that could be negotiated for the subcomponents.

Buyer and seller matrices were inversely related; that is, the buyer's revenue or profit for negotiated terms of a component increased when the seller's decreased, and

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[1] It should be noted that no negotiators failed to reach an agreement. Additional rounds may have yielded further insight, but the excessive time required for the experiment—approximately 90 minutes—did not permit further negotiations.

Exhibit 1
Buyer and Seller Profit Schedules

Profit Schedule: Buyer

Negotiation Terms	*Component X*	*Component Y*	*Component Z*
1	3,000	1,400	1,200
2	000	000	000
3	1,000	600	400
4	2,000	1,200	800
5	4,000	1,600	1,600

The negotiated terms which you and the seller division have agreed upon are: (Please indicate the number and the amount for each component.)

	Component X		*Component Y*		*Component Z*		TOTAL
The Terms:	______	–	______	–	______		
The Amount:	______	+	______	+	______	=	______
OR							

NO AGREEMENT—Buyer's Profits in outside market=$5,720
Seller's Profits=$-0-

Profit Schedule: Seller

Negotiation Terms	*Component X*	*Component Y*	*Component Z*
1	400	600	1,000
2	1,600	1,600	4,000
3	1,200	1,400	3,000
4	800	1,200	2,000
5	000	000	000

The negotiated terms which you and the buyer division have agreed upon are: (Please indicate the number and the amount for each component.)

	Component X		*Component Y*		*Component Z*		TOTAL
The Terms:	______	–	______	–	______		
The Amount:	______	+	______	+	______	=	______
OR							

NO AGREEMENT—Buyer's Profits in outside market=$5,720
Seller's Profits=$-0-

vice versa. The matrices were also designed to be symmetrically proportional over all components to reflect equal buyer and seller bargaining strength. For component X, for example, the buyer's profits increased by $1,000 increments for terms of 2, 3, 4, 1, 5, respectively, while the seller's profits for the Z component decreased by similar amounts over the same contract terms. Similar inverse proportional gains and losses occurred for component Z for the buyer and for component X for the seller, as well as for component Y for both the buyer and the seller. As in previous experiments, this symmetrical structure controlled differences in *a priori* bargaining power, necessary for independent variable manipulations.

Of the 5×5×5 possible negotiable terms, many were not Pareto efficient—i.e., both parties could be made better off by moving towards the efficiency frontier. However, only one point along the frontier ($5,200–$5,200) maximized firm profits and resulted in no divisional profit differences.

From all possible profit combinations provided in the matrix, the buying and selling divisions were required to negotiate a single subcomponent agreement. The values of these agreements under different treatment conditions constituted the dependent variable used for statistical analysis. Firm profits were measured as the sum of divisional profits resulting from the agreement between the negotiating divisions. Divisional equity was measured by the difference of the negotiated outcomes of the two divisions. As an example, in exhibit 1 an agreement of 1-3-5 for components X, Y, and Z, respectively, would result in buyer profits of $3,000+$600+$1,600=$5,200 and seller profits of $400+$1,400+$0=$1,800. Firm profits for that agreement were $5,200+$1,800=$7,000, and divisional profit differences were $5,200−$1,800=$3,400. It should be noted that divisional profit differences could be low with profits still below optimal (consider a 4-4-4 agreement), or profit differences could be high with firm profits still relatively high (consider a 5-5-2 agreement). At only one point, 5-4-2 in exhibit 1, was firm profit maximized and divisional equity maintained.

Treatments

When external markets were absent, the two divisions were required to reach a negotiated agreement for the three subcomponents based solely on their respective profit schedules. Thus, no uncertainty was present and equal bargaining strength was maintained. This treatment is analogous to a bilateral monopoly situation frequently found if no market for an intermediate product exists.

With market alternatives present, an opportunity for defection from a potentially integrative agreement existed. An outside market price, known to both divisions, was made available randomly for one division, which permitted an increase in its profitability by ten percent beyond the coordinative ($5,200–$5,200) Pareto optimal point (see exhibit 1).[2] The firm could also be better off in some cases if the division were to go outside (consider a 2-2-5 agreement). In other words, the buying or selling division had an opportunity to use the outside price as a bargaining tool.

In the certain markets case, each division was informed that in the subsequent period a market alternative would be available to the division manager, who was without a market alternative during the current negotiation.[3] However, the amount of the future market alternative was unknown. In the uncertain markets case, divisions were informed that there was only a 50 percent chance that either division would have an external market available in any subsequent period. To control for possible differences in buyer-seller behavior, market alternatives were counterbalanced between buyers and sellers over all treatments. The next period's profit matrix and the amount of the next period's outside offer were not known in any of the treatments.

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[2] If market alternatives beyond the optimum were available to both parties, the problem is assumed away. A new optimal point is defined whereby the firm benefits if both parties simply go outside the firm.

For the "negotiation history" manipulation, subjects were first informed that they would negotiate only once with their current partners. After this single-period negotiation, subjects switched partners for the multiperiod sessions. The order of the single-period/multiperiod manipulation was counterbalanced across treatments. Subjects were informed that negotiations in the multiperiod session would occur indeterminately over several sessions so as to prevent terminal gaming effects.[4]

The final manipulation involved two levels of incentives, divisional and mixed (firm and divisional). The former consisted of rewarding each subject based solely on a percentage of the divisional profits generated from the negotiated transfer price. This allowed subjects to earn, on average, \$5.23 for the total negotiation session. The mixed scheme rewarded subjects on a percentage of both their divisional and firm profits so that at coordinative firm optimal equilibrium, 5-4-2 in exhibit 1, the weighting was nearly equal for divisional and firm profits.[5] Also, at this point the divisional-incentive payment was approximately equal to that earned under the mixed-incentive scheme. In other words, both schemes rewarded divisional profit maximization to differing degrees. Under the mixed incentive, both divisional and company profit schedules were given to each division. To prevent each division from inferring the other's profit schedule, the company's profit schedule was adjusted by a constant (multiplying by 1.1).[6] At the conclusion of each negotiation session, profit feedback about outcomes of both divisions was provided to subjects.

III. Results

Manipulation Checks and Subject Covariates

Subjects rated on a five-point scale their belief in the degree of uncertainty, their understanding of the reward scheme, and their degree of motivation for cooperative behavior. Analyses of these ratings indicated that all manipulations were successful ($t=2.97$, $p \leq 0.01$ for uncertainty; $t=1.95$, $p \leq 0.05$ for reward scheme; and $t=4.56$, $p \leq 0.001$ for cooperative motivation).

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[3] Repeated market alternatives available only to the same division would simply be considered a problem of monopoly, eliminating the rationale for negotiation.

[4] To maintain the independence of the observations over time, the buyer and seller matrices were multiplied by a different scalar each period and rows were randomly interchanged. Subsequently, the dependent variables were converted by the same scalars to standardize negotiated outcomes for statistical analysis. This is mathematically equivalent to comparing relative efficiency measures X_i/X_{*i} on the untransformed matrices.

[5] Although other, more extreme, mixed-incentive scheme manipulations were possible, most notably a 25:75 and a 00:100 divisional firm split, such schemes would lessen the need for interdivisional negotiation.

[6] Debriefing results indicated no ex *ante* knowledge of the opponent's profit matrix. As in the divisional treatment, this permitted subjects to earn approximately five dollars over the multiperiod negotiations. Additional corroboration for absence of learning was provided by statistically comparing single-period results derived prior to and following the post-multiperiod. No significant differences were found between any of the treatments.

Table 1
Divisional Profit Differences
MANOVA (Incentive × Market × History)

Source	SS	*df*	*MS*	*F*	*Sig.*
Total	313,556,867				
Between Subjects	218,210,341	66			
Market	21,392,232	2	10,696,116	3.58	0.034
Incentive	49,839	1	49,839	0.02	0.898
Market × Incentive	14,582,316	2	7,291,158	2.44	0.096
Error	182,185,954	61	2,986,655		
Within Subjects	95,346,526				
History	1,079,404	2	539,702	0.77	0.467
History × Market	5,261,179	4	1,315,295	1.87	0.120
History × Incentive	1,194,475	2	597,238	0.85	0.431
History × Market × Incentive	1,906,540	4	476,635	0.68	0.609
Error	85,904,928	122	704,139		
$\omega^2 = 10.3\%$					

In addition, debriefing information was analyzed using a repeated-measures covariate analysis. The covariates—age, education, major, sex, job experience, grade point average, negotiation experience, and roles as either buyer or seller—were not significant. Finally, learning was evaluated by comparing single-period results both pre- and post-multiperiod bargaining, with no significant differences noted.

Divisional Profit Differences

To examine hypotheses H_{1a}, H_{2a}, and H_{2b}, which were based on divisional profit differences as the dependent measure, a 2×3×3 (Incentive by Market by History) repeated measures MANOVA was used (single-period results are discussed later). The MANOVA results, reported in table 1 and figure 1, do not support hypothesis H_{1a}, suggesting that a divisional reward scheme does not lead to divisional inequities that are significantly greater than those occurring under a mixed-incentive profit-based scheme.

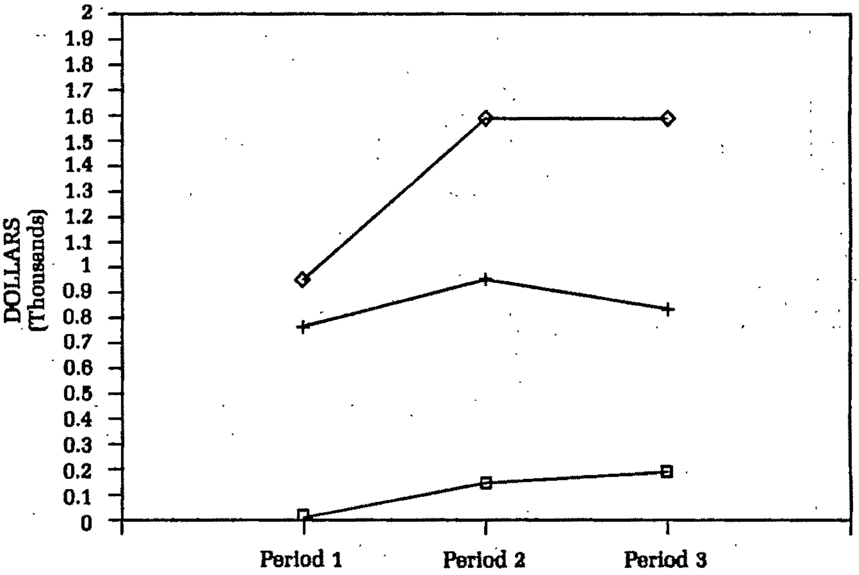
However, data in table 1 and panels A and B of figure 1 are consistent with hypothesis H_{2a} ($F=3.58$; $p \leq 0.034$) and marginally support hypothesis H_{2b} ($F=2.44$; $p \leq 0.096$). In particular, panel A of figure 1 shows a dramatic increase in divisional profit differences as uncertainty increases under the divisional-incentive scheme. The mixed-incentive results in panel B are less convincing. With the exception of the first multiperiod negotiation, divisional profit differences are not significantly different due to the certainty manipulation.

Firm Profits

Hypotheses H_{1b} and H_{3b} were examined using a 2×3×3 MANOVA (Incentive by Market by History) where history was a repeated-measures variable. The negotiated profit of the two divisions was the dependent measure. Table 2 and panels A and B of figure 2 illustrate the results. The MANOVA results are consistent with hypothesis H_{1b}

Figure 1
Divisional Profit Differences

Panel A. Divisional Incentives:



Panel B. Mixed Incentives:

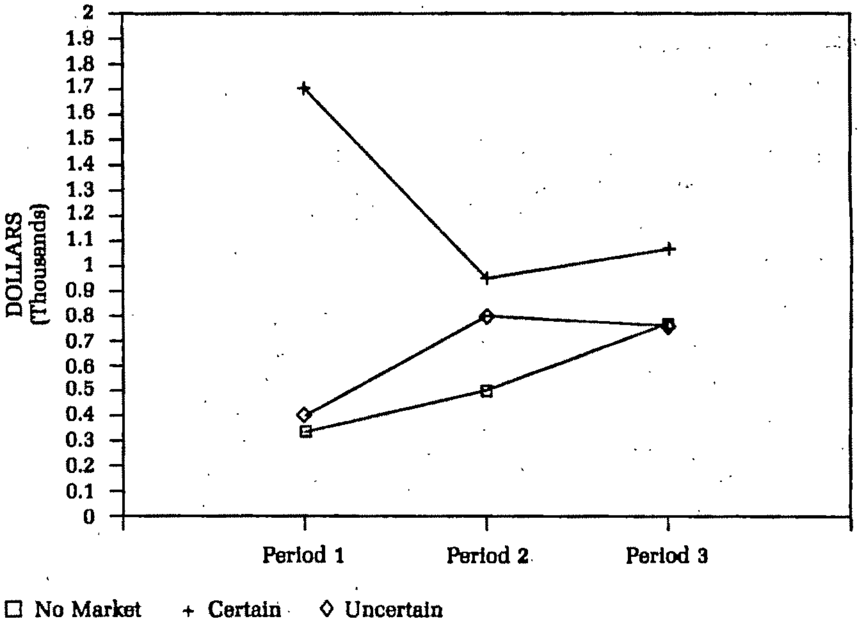


Table 2
Company Profits
MANOVA (Incentive × Market × History)

Source	SS	*df*	MS	*F*	Sig.
Total	56,585,547				
Between Subjects	42,420,069	66			
Market	600,125	2	300,062	0.49	0.612
Incentive	4,507,475	1	4,507,475	7.43	0.008
Market × Incentive	291,080	2	145,540	0.24	0.788
Error	37,021,389	61	606,908		
Within Subjects	14,165,478				
History	880,579	2	440,290	4.34	0.014
History × Market	653,477	4	163,369	1.61	0.176
History × Incentive	79,947	2	39,973	0.39	0.675
History × Market × Incentive	185,376	4	46,344	0.46	0.767
Error	12,366,099	122	101,361		
$\omega^2=8.5\%$					

($F=7.43$; $p\leq 0.008$). Outcomes are significantly higher under all treatments for the divisional-based incentive scheme.

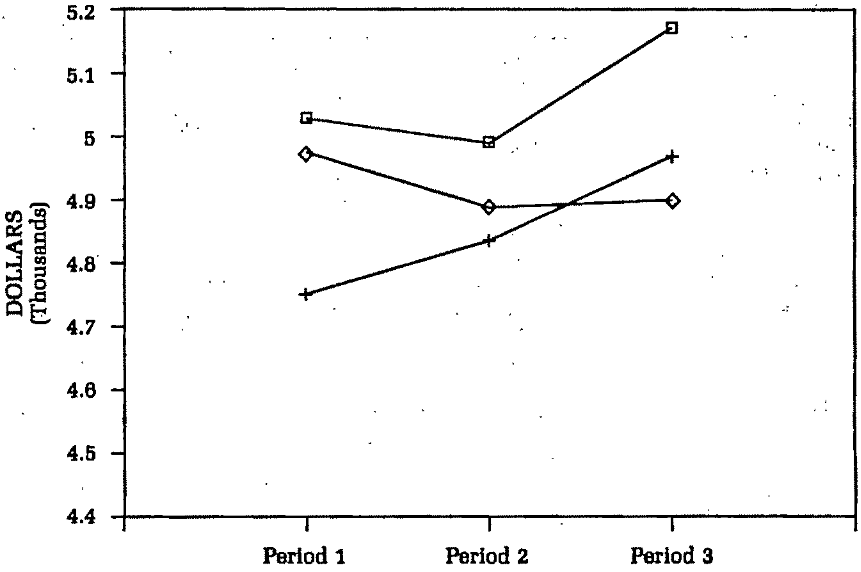
Hypothesis H_{3b} predicted an increase in company profits across the multiperiod session. Because statistical analysis indicated a violation of the sphericity conditions for the repeated-measures variable, the Greenhouse-Geisser adjustment to the degrees of freedom for the *F*-test was applied. The results were significant, as displayed in table 2 ($F=4.34$; $p\leq 0.014$). Figure 2 indicates that improvement in firm returns occurred primarily in period three. Negotiators apparently required more than one period to accumulate sufficient understanding about their negotiating partner's strategies.

Since future market uncertainty could not be manipulated in a single-period context to examine hypothesis H_{3a}, this manipulation was eliminated and a 2×2×2 ANOVA (Incentive by Market by History) was performed. The history manipulation consisted of the single-period versus the final multiperiod sessions. The certainty manipulation consisted of no outside market versus a certain outside market offer. The ANOVA results for hypothesis H_{3a} are presented in table 3. The history manipulation exerted a significant main effect on firm profits, confirming H_{3a} ($F=5.52$; $p\leq 0.024$). In addition, the reward variable was highly significant, further supporting hypothesis H_{1b} ($F=8.13$; $p\leq 0.007$). Overall, the results strongly support the postulate that the length of the negotiation history is a significant variable with regard to negotiated outcomes.

The frequency of maximum firm profit attainment using a coordinative equilibrium strategy is depicted in figure 3. This strategy maximized firm returns and gave equal payoffs to both divisions. As can be seen, this bargaining strategy accounted for more outcomes over all cells than all remaining strategies combined. These results further corroborate the finding that divisional incentives outperformed mixed incentives. Under divisional incentives, negotiators maximized firm profits in multiperiod bar-

Figure 2
Company Profits

Panel A. Divisional Incentives:



Panel B. Mixed Incentives:

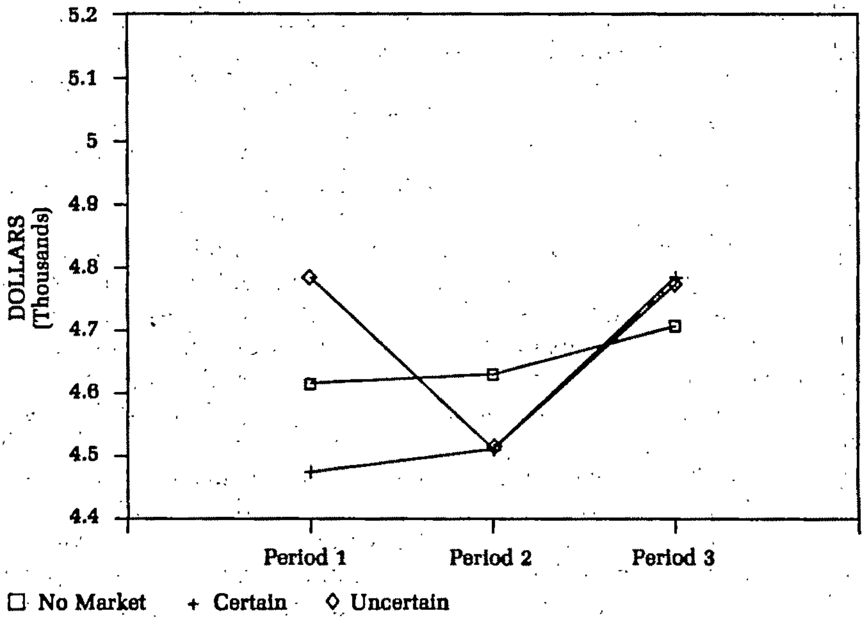


Table 3
Company Profits: Single Period Versus Final Multiperiod ANOVA (Incentive × Market × History)

Source	SS	df	MS	F	Sig.
Total	34,211,810				
Between Subjects	21,464,974	43			
Market	561,167	1	561,167	1.30	0.262
Incentive	3,520,791	1	3,520,791	8.13	0.007
Market × Incentive	56,286	1	56,286	0.13	0.720
Error	17,326,730	40	433,168		
Within Subjects	12,746,836				
History	1,480,114	1	1,480,114	5.52	0.024
History × Market	231,282	1	231,282	0.86	0.359
History × Incentive	128,103	1	128,103	0.48	0.494
History × Market × Incentive	173,307	1	173,307	0.65	0.426
Error	10,734,030	40	268,350		
$\omega^2 = 12.8\%$					

gaining sessions in 61 of 108 cases versus 46 for the mixed-incentive scheme ($\chi^2 = 5.9$; $p \leq 0.05$).[7]

When comparing divisional profit differences with firm profit results, it becomes clear that a nonlinear relationship exists. This appears to be driven by uncertainties in the negotiation process. Panels A and B of figure 4 illustrate this relationship. The data for figure 4 are the marginal means for total profits and profit differences for the divisional- and mixed-incentive schemes. As can be seen, firm profits are maximized in all markets under divisional incentives. Divisional profit differences are also less under divisional-incentive schemes in all but uncertain markets. Under certain conditions, divisional incentives may be a necessary ingredient in maximizing firm profits, without jeopardizing performance evaluation. The key to determining the impact of negotiated transfer pricing on firm profitability may reside in further understanding the relationship between incentive schemes and environmental uncertainty.

IV. Discussion

This study examined the effect of incentive schemes, markets, and negotiation history upon decentralized transfer pricing. Speculation that divisional reward schemes will lead to suboptimal returns has yet to be empirically supported (see, e.g., Spicer 1988 or Grabski 1985). Lambert's (1979) survey suggests performance evaluation problems in the presence of divisional rewards but ignores the impact on company profits.

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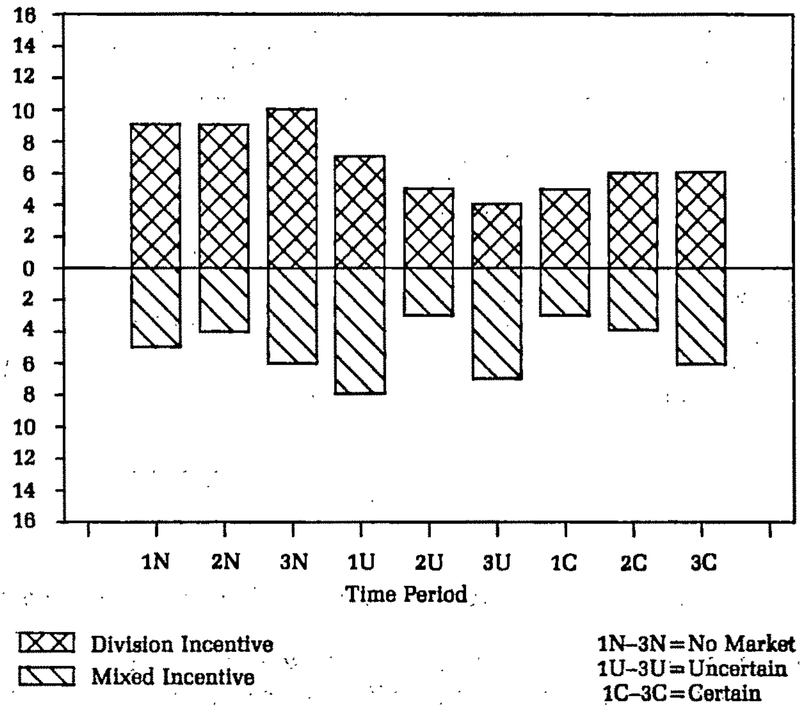
[7] The χ^2 table appears below:

Rewards	*No Market*	*Certain*	*Uncertain*
Divisional	28	17	16
Mixed	15	13	18

Figure 3
Frequency of Maximum Company Profit Outcomes



Ackelsberg and Yukl (1979) were able to demonstrate less cooperative behavior from divisional incentive schemes, but also could not demonstrate lower company profits.

Results of this study indicate that divisional profit-based rewards can motivate negotiators to achieve higher company profits. Divisional equity was also maintained under divisional incentives except under market uncertainty. The results support the importance of uncertainties on negotiated outcomes. Kaplan (1982, 497) argues:

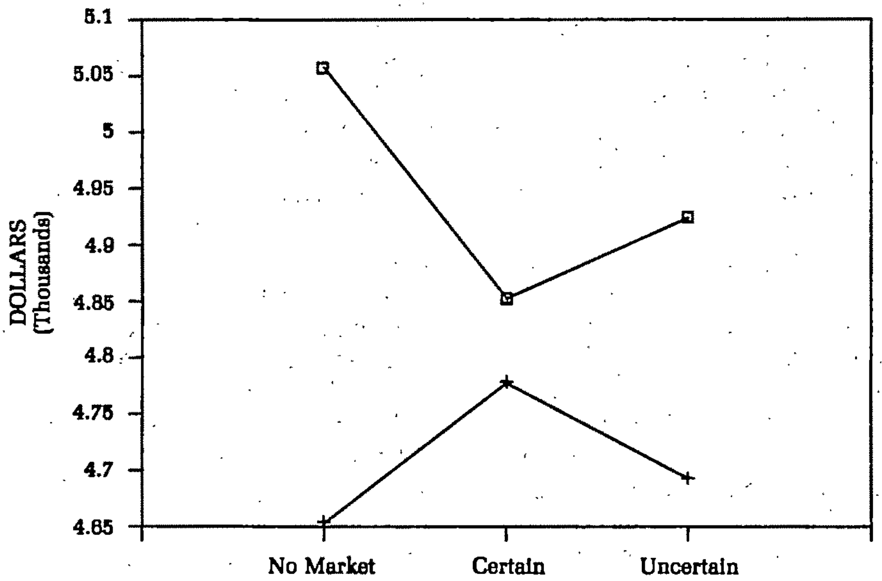
> Accounting and economic researchers now realize that under conditions that make decentralization worthwhile—that is, an uncertain environment with private information possessed by local managers—we do not know a great deal about optimal transfer pricing policies.

Together, the market and incentive scheme results imply that some divisional conflict may be a necessary ingredient in achieving optimal company profits. In this experiment, the divisional reward scheme fostered larger company profits than the mixed scheme, even when high uncertainties about the existence of a market created more chance for opportunistic behavior. Additional research is necessary to understand the relationship between conflict, profits, and reward scheme design. Future research should address the impact of different types of environmental uncertainties on company profits.

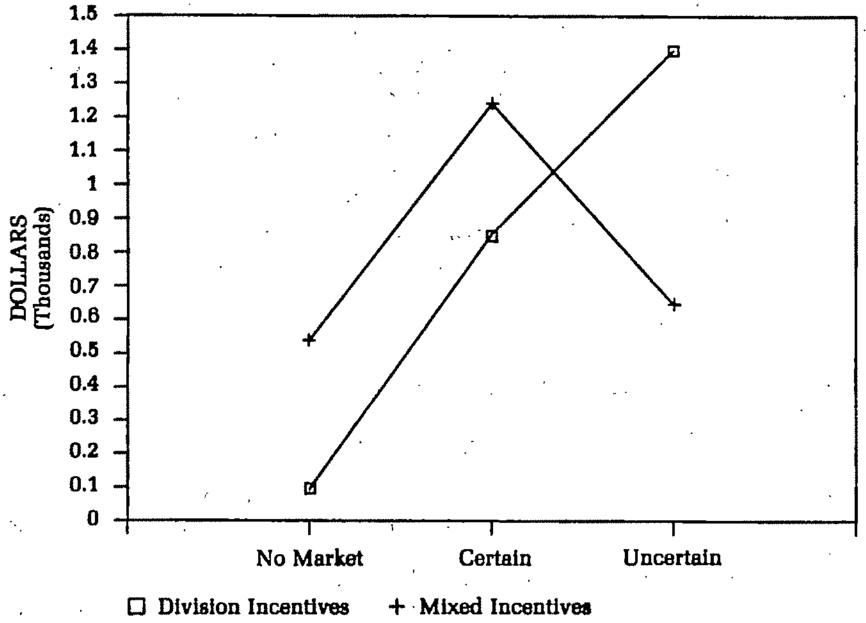
Bargaining history was also shown to have a significant impact on negotiated profits. Company profits improved significantly over the multiperiod session and were sig-

Figure 4
Firm Profits and Division Differences

Panel A. Marginals for Profits:



Panel B. Marginals for Differences:



nificantly larger in the final multiperiod session than in the single-period negotiation. Nor were the results attributable to learning. Rather, they suggest an evolution in bargaining strategy over time. This is consistent with prior game theory findings and the only transfer-pricing study that examined this issue experimentally (Voissem and Sistrunk 1971; DeJong et al. 1989). Although game theory researchers have long recognized the importance of player strategy in multiperiod settings, most accounting research has viewed negotiated transfer pricing as static rather than dynamic. Additional research manipulating strategies to create a variety of negotiating histories would provide insight regarding the impact of negotiation history.

Implications of the findings are that negotiated transfer prices in a decentralized environment do not always attain the desired objectives of company profit maximization and equitable divisional performance evaluation. This is particularly true with short negotiation histories and in uncertain market environments. The results of this study suggest that one way to mitigate these dysfunctional consequences is through the design of the company's incentive system. In the presence of uncertainty and short negotiation histories, mixed-incentive schemes can lead to more integrative agreements, benefiting both the company and the division.

Several experimental limitations should be noted in interpreting the results. First, the findings are limited to the parameter configurations employed in the experiment. Only one level of market price was experimentally manipulated. Presumably, the observed dysfunctional firm and divisional results would only be further exacerbated as market price defection opportunities increased in magnitude. Due to time constraints, only three periods were investigated. Additional multiperiod sessions could allow negotiators to better observe strategies and perhaps foster more cooperative behavior. While strategies may not have stabilized after three periods, both the trend and significance of the history variable suggest that additional time periods should strengthen rather than change the direction of the results of this variable.

External validity limitations caution against drawing implications for corporate transfer-pricing policies. These limitations include the fact that division managers invariably interact and negotiate over issues other than transfer pricing and that more than two divisions are frequently involved in transfers. A more sophisticated laboratory or field study could address the former and a coalition methodology could provide important theoretical extensions in the latter case. The results of this study suggest that many questions remain unanswered and that more work remains to be done.

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A Perspective on Negotiation Research in Accounting and Auditing

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SYNOPSIS: This paper proposes that interactions in accounting and auditing can be viewed as a large negotiation system. We define negotiations broadly to include any context in which two or more parties with differing preferences jointly make decisions that affect the welfare of both (all) parties. After a brief overview of negotiation research, the paper: (1) shows how recent research in accounting and auditing has implicitly addressed various aspects of negotiations; (2) comments on the Elias (1990) and Chalos and Haka (1990) studies which appear in this issue; (3) discusses departures from decision maker rationality which may seriously affect negotiations; and (4) uses three scenarios to highlight the importance of three negotiation issues (third party processes, the coordination of work groups, and social dilemmas) in accounting. We conclude by suggesting that a multifaceted research strategy, combining theory, description, and prescription, provides the greatest potential for progress in the study of accounting and auditing negotiations.

Key Words: *Negotiation, Bargaining, Research, Theory.*

ALTHOUGH people commonly think of negotiations as having well-defined boundaries (such as negotiating a contract, buying a house or a used car, or bargaining at an open air market), many other interpersonal interactions can be easily interpreted as negotiations. We define negotiations broadly to include any context in which two or more parties with differing preferences jointly make decisions that affect

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the welfare of both (all) parties. Thus, the dynamics of bargaining are important in many interactions, including those within accounting and auditing.

Indeed, our definition suggests that many accounting and auditing interactions include negotiations, for example, among shareholders, managers, potential lenders, investors, analysts, and other accountants and auditors. A large system of accounting and auditing negotiation, then, encompasses an array of interpersonal contacts and incorporates information and reports as important mediating mechanisms within the system.

Incentives to cooperate and incentives to compete run through these accounting/negotiation situations, as they do through most interactions. Within the accounting system, accuracy and the push toward economic benefit are also basic philosophical assumptions. They are not independent, however: differing opinions and presentations of facts (acknowledging several different standards for accuracy) can affect the pursuit of economic benefit of actors in the system.

Examples

The following three accounting scenarios are examples of negotiation. We will discuss each of them later to highlight how research on negotiation can contribute theoretically, empirically, and prescriptively to the field of accounting.

Scenario One. A firm is troubled by terrific strife between the owners and the chief executive officer (CEO). Although they have been experiencing considerable conflict, the owners are reluctant to replace the CEO because she is so effective. During this conflict the owners have decided to change auditors and hire a new accounting firm to handle their audits and tax advice. The partner who has landed this new account gets the impression that the company is hiring him and his colleagues to mediate between the CEO and the owners. At the same time, however, the company refuses to treat the auditors as management consultants. The partner must decide: Is the account worth acquiring? Can the auditors expect to do a reasonable job? If so, how?

Scenario Two. An accounting firm has decided to offer its clients more comprehensive financial and consulting services. To accomplish this goal, the partners have also decided that they must form independent work groups to handle all, or almost all, of the client's auditing and consulting needs. A client will continue to deal with a single partner, but the partner will now oversee several distinct "Advising Groups." The partners realize that decisions about the composition of their new groups will be difficult. Should they balance the groups technically or ensure that the group members can work well with each other? How should they balance expertise and authority within and across the groups? What is of primary importance?

Scenario Three. In recent years, the starting salaries for entry-level accountants have increased at rates above inflation. The supply of new accountants rarely meets the demand, and some firms have greater need for new staff than others. In addition, pay increases must obviously come from firm and partner profits. Each firm has an incentive to reduce the tendency for the industry to increase starting salaries. Yet each firm, to various degrees, wants to be competitive in recruiting. Can any firm bid less than the others and still expect to hire enough talent to satisfy demands? How can long-run mutual interests overcome short-term needs that drive the firms to be self-destructively competitive?

We argue that the multitude of negotiations embedded within the accounting system naturally pushes the parties to and from equity, depending on regulations that remove individual advantages and bargaining tactics that retain those advantages (see Lev 1988 for an alternative view). An omniscient view of the system might suggest that equity is not an equilibrium condition and that the possibility of substantial economic benefits undermines actors' motivations to negotiate an equitable system.

In the sections that follow, we review some research in accounting that documents the importance of studying the behavioral aspects of negotiation. Next, we review the two negotiation studies that appear in this issue of *The Accounting Review* to highlight the potential in this area. Finally, we conclude with an assessment of the characteristics of future research that could have long-term effects on accounting research and practice.

The Field of Negotiations, 1990

Research on negotiations and conflict is currently expanding rapidly. A variety of new organizations, including the National Institute for Dispute Resolution, the International Association for Conflict Management, and the Power, Negotiation, and Conflict Management group in the Academy of Management all indicate that the field is burgeoning, especially in managerial contexts. Also, other fields such as experimental economics, anthropology, and political science are all paying careful attention to negotiation issues (e.g., Axelrod 1984; Smith 1989).

Our interest in negotiation does not mean that we are encouraging a competitive approach to accounting and auditing. On the contrary, the current trend in negotiations and conflict management might well be regarded as an attempt to strongly advocate the value of cooperation (e.g., Fisher and Ury 1981). More realistically, it's important to recognize the mixed motives (i.e., cooperation and competition) in most interactions (Walton and McKersie 1965; Raiffa 1982; Murnighan 1991; Neale and Bazerman 1991). Although cooperative behavior is socially acceptable, the structure of many conflict situations may induce decidedly competitive behavior (Seybolt and Murnighan 1990). Consideration of both cooperation and competition, then, is essential for a clear understanding of negotiations.

Although research on face-to-face negotiations is not within the main stream of research in accounting, the issue of how parties with diverse preferences make decisions has been at the core of contemporary accounting research. Principal-agent models are an influential theoretical perspective in accounting. A rich formal literature (e.g., Baiman et al. 1987; Demski and Sappington 1989) poses auditors as a potential mechanism to help principals solve agency problems. Like game theory (Myerson 1990), agency theory typically analyzes the behavior of fully rational actors in a variety of contexts. Until very recently, researchers provided few empirical tests.

Recent research has begun to behaviorally address both agency models and general negotiation problems in accounting (Newman and Noel 1989). Even so, empirical work on agency theory (notable exceptions being DeJong et al. 1985; Dopuch et al. 1989) has not kept pace with theoretical developments. The two papers on negotiations in this issue provide substantive examples of the relevance of bargaining in the field of accounting. Other recent papers include studies cited by Solomon (1987) on audit groups and arguments by Ashton et al. (1988).

The Accounting/Auditing Negotiation Environment

A brief, selective review of recent research in the field supports our (biased) view that the accounting/auditing environment consists of a large negotiation system. We cannot be exhaustive here (for broader coverage see Abdel-khalik et al. 1990; Watts and Zimmerman 1990); at the same time, we are not comprehensive in our selection of accounting and auditing contexts. The studies mentioned here only rarely address negotiation explicitly; by reviewing them together, however, we can easily identify the underlying influence of negotiation within the field of accounting.

Recent accounting and auditing studies seem to focus on six types of actors, to varying degrees: managers, clients, employees, accountants, creditors, and shareholders. The bulk of the work focuses on manager and accountant behavior, with less emphasis on the others.

Managerial Action

Research in this domain examines three basic issues: (1) whether managers used or tried to use accounting mechanisms to negotiate an increase in their benefits (Watts and Zimmerman 1979); (2) whether they used or tried to use accounting mechanisms to negotiate the attractiveness of their company for investors (Gordon 1964); and (3) whether they reacted to negotiation attempts by other actors within the system as various psychological theories predict.

Examples of researchers studying some aspect of negotiation in accounting include Deakin (1989), who showed that firms often lobby for changes in accounting methods that will benefit them; Collins et al. (1987), who showed that managers play various games to influence the budget formation process; Defeo et al. (1989), who presented some evidence that equity-for-debt swaps increase executive compensation; and Abdel-khalik et al. (1987), who showed that executive salaries and bonuses increased following (real) changes in their firm's accounting procedures. In counterpoint, Johnson (1987) and Tehranian et al. (1987) argued that the available evidence suggests that accounting mechanisms may be used to boost executive compensation, but that the effects are quite weak.

Among the studies of the use of accounting methods to negotiate a company's profile are Trueman and Titman's (1988) presentation on income smoothing; Carslaw's (1988) suggestion that companies adjust income levels to reach certain key figures (e.g., $1 billion rather than $999 million); Hand's (1989) finding that equity-for-debt swaps smoothed income curves; and Craswell's (1989) documentation of the strategic switching of auditors by British firms after issuing seriously qualified opinions. Liberty and Zimmerman (1986) investigated the possibility that managers manipulated earnings before labor-management negotiations to make the company look worse rather than better; their results showed no clear evidence of this type of pre-bargaining behavior.

Studies of managers' psychological responses include research by Kanodia et al. (1989), who argued that the escalation of commitment or investment in a failed course of action may be an economically rational rather than a psychological choice; by Brown and Solomon (1990), who put subjects in the roles of advisor and evaluator of a budgeting committee's decision and showed that a cognitive schema explanation accounted for the effects of hindsight better than two other theoretical explanations; and by Harrison et al. (1988), who supported an attribution model's interpretation of superior and subordinate reactions to a subordinate's task failure: subordinates made more situational attributions for their performance, whereas superiors made more dispositional attributions. The combination of these two divergent interpretations of the same event, of course, provides fertile ground for conflict and various strategies for conflict resolution.

Research has also investigated how competing motivations affect the (negotiated) choice of a firm's basic accounting system (Lindahl et al. 1988). Niehaus (1989) showed that manager-owned firms are more likely to prefer FIFO whereas shareholder-dominated firms tend to prefer LIFO; Hughes and Schwarz (1988) argued that the choice of LIFO or FIFO systems presents managers with a difficult company-benefit versus self-benefit tradeoff; and Watts and Zimmerman (1986) discussed the effects of political sensitivity on the choice of accounting procedures.

Auditor Action

Several studies have examined auditors' negotiations. For example, Ashton et al. (1987) document negotiation activities by auditors who delayed reports including qualified opinions or losses. The recent literature shows that auditors negotiate their fees for a new client, lowering them an average of 24 percent the first year and 15 percent the next two years (Simon and Francis 1988); and that the likelihood of a materiality judgment increases with the percentage of income involved (Chewning et al. 1989; Holstrum and Messier 1982). Research has also shown that auditors with experience perform better on semi-structured and unstructured tasks (Abdolmohammadi and Wright 1987); that the consensus of their judgments increases with their experience with the same supervising auditor (Meixner and Welker 1988); that they are more likely than managers to absorb uncertainty by negotiating fixed rather than cost-based contracts, especially in the early years of their relationship (Palmrose 1989); and that they tend to be confident of their memory not only when they are actually accurate, but also when they have made incorrect inferences from information they have seen a day before (Moeckel and Plumlee 1989).

Other Negotiation Behaviors

Experimental subjects in the role of employee misrepresented their skills when doing so meant that they obtained higher personal payoffs (Baiman and Lewis 1989). CPAs were more liberal (i.e., favoring clients) in their tax judgments than non-CPAs (Ayres et al. 1989). Evans and Patton (1987) discussed the use of signaling in public sector accounting: by the use of cheap talk (e.g., advertising that its management was highly responsible), a city might effectively negotiate lower loan interest. Finally, Palmrose (1988) documented the long-term negotiation between clients and auditors (i.e., litigation) when users suffered losses from materially false or misleading financial information.

In one study of agency theory, DeJong et al. (1985) showed that an equilibrium model predicted prices quite accurately and that disclosure of the agents' fees and limited agent liability increased expected profits. In another study of agency theory, by Dopuch et al. (1989), the results showed that (when possible) buyers purchased credibility mechanisms to check on the seller's honesty and sellers purchased credibility mechanisms to substantiate their own claims, increasing market efficiency and reducing moral hazard. Lagged feedback on the seller's honesty led to less cooperation and efficiency when credibility mechanisms were not available.

Two Explicit Studies of Negotiation

All these studies document many aspects of negotiations within the field of accounting. Nevertheless, most did not focus on the topic of negotiation per se; instead, negotiation was implicit in their discussion. In this section, we review two new experimental studies that focused explicitly on negotiations in accounting. Elias (1990) and Chalos and Haka (1990) studied mixed-motive, bilateral negotiations, the predominant domain of negotiations research. Both studies explicitly examined the information held by the bargainers, an approach with a long tradition in the literature, from Siegel and Fouraker's (1960) early work to more recent research (Roth and Murnighan 1982; Roth et al. 1988).

Both studies posited that one party's lack of information about the other could lead to less trust between them and a more competitive interaction. The two studies differ markedly in the outcomes they observed: because of the strong conflict inherent in the task, Elias observed almost no agreements (only three out of 40). The Chalos-Haka task, on the other hand, where agreements were much more valuable than disagreements, generated only agreements.

The Elias Study

Elias studied the type of financial information that many companies vainly hope they can withhold from union negotiators (i.e., large profits) or that they might openly reveal (i.e., serious losses). The analysis did not extend to the long-term problem facing companies that eventually recover from bad times: by releasing financial information now, they may foster union expectations that they will release this information in the future. When they finally achieve nice profits, they may want to withhold this information. The combination of previous revelation and current secrecy, however, may escalate the union's estimates of the company's profits to heights beyond their actual value. Thus, the long-term costs of revealing short-term financial information should lead management to pause before they reveal their losses.

We do not fault the study for its short-term focus. On the contrary, the data provide the basis for several theoretical tests and for addressing additional questions. In particular, if we reify the data by assuming that they represent actual collective bargaining interactions, we can consider the effects of profits and losses and the presence or the absence of shared information from the strategic point of view of each party.

Table 1 rearranges the data from Elias's original table 1 and reports a series of analyses of variance including losses versus profits and revealed versus private information (symmetric vs. asymmetric in Elias's original explication) as independent variables and the perceptions and offers at impasse of the management and union bargainers, analyzed separately, as dependent variables.

Union negotiators with no information about the company's finances had significantly higher expectations than informed union negotiators. This finding suggests the hypothesis that not knowing may allow a negotiator to formulate quite unrealistic expectations about the upcoming negotiation and its outcomes. This result would be quite consistent with a multitude of findings on decision-maker and negotiator overconfidence (e.g., Einhorn and Hogarth 1978; Bazerman and Neale 1982).

The union negotiators' expectations of good, poor, fair, and expected agreements were all affected by information that the company had lost money: they expected worse outcomes in each case, compared to the profit or unrevealed information conditions; differences were significant for good and fair expectations. Their average offer at impasse was not additionally affected by information revelation: they simply asked for more when the company had been profitable and less when it hadn't. Thus, their expec-

Table 1

The Mean Pre-Negotiation Expectations, Post-Negotiation Satisfaction, and Impasse Offers of Management and the Union (Data from Elias 1990)

	Union							*Management*						
	Previous Management Losses		*Previous Management Profits*		*F-ratios*[a] *p<*			*Previous Management Losses*		*Previous Management Profits*		*F-ratios*[a] *p<*		
	Uninformed Union	*Informed Union*	*Uninformed Union*	*Informed Union*	*P/L*	*Inf.*	*Int.*	*Uninformed Union*	*Informed Union*	*Uninformed Union*	*Informed Union*	*P/L*	*Inf.*	*Int.*
Pre-Negotiation Perceptions:														
A Good Settlement	9.0	7.5	9.7	8.9	02	01	33	2.8	2.9	3.1	3.3	36	62	83
A Poor Settlement	4.0	3.1	5.2	3.7	18	09	64	7.2	7.2	5.5	6.4	21	66	66
A Fair Settlement	7.7	6.3	8.6	7.7	03	03	66	3.3	3.8	3.4	4.3	39	05	43
Expected Settlement	8.1	6.4	7.9	7.5	38	06	21	3.6	3.7	3.5	4.3	59	32	34
Post-Negotiation Satisfaction:	4.2	3.6	3.5	5.6	91	51	02	4.3	4.3	4.7	3.6	12	15	67
Impasse Offer (% increase)	7.7	7.5	6.6	6.6	13	89	89	2.9	2.8	3.2	4.1	05	24	19

[a] The three columns beneath "F-ratios" list the *p*-values of the univariate main effects for Profits/Losses (P/L), Information, and their interaction, within the responses of the union or the management negotiators, analyzed separately. Degrees of freedom were 1 and 36 for most tests, 1 and 33 for the others.

tations may have been tempered by the negotiations, as Elias suggests, and were ultimately affected only by profits versus losses. At the same time, however, union negotiators were most satisifed when they dealt with a known profitable company and least satisfied when they negotiated in ignorance of profits (which the management negotiator, presumably, resisted revealing) or in knowledge of losses.

Reanalyses of management's expectations and actions are also interesting. Their expectations for a fair agreement were significantly better when the union was not given profit or loss information. Also, although not significant, the means for expected settlements suggest that management negotiators were most pessimistic when union negotiators were informed of previous profits. In the end, management representatives responded significantly to previous profits and losses as the union representatives did: they offered more when they had profits rather than losses, and somewhat (not significantly) more when the union had been informed of these profits. Management negotiators may have believed that they were successful in hiding their profits when the union negotiator began with no information.

For the most part, the two sides viewed the dispute as we would expect: the union was satisfied when management wasn't, and vice versa; both offered a higher final wage when the company had been profitable. The largest disparity in expectations came when the union had no information about the company's profits or losses. Yet, they reached a similar endpoint (i.e., impasse offer) within the profit and loss conditions, regardless of their original information.

The Chalos and Haka Study

The Chalos and Haka study follows a long tradition of interest in transfer pricing in the accounting literature (e.g., Abdel-khalik and Lusk 1974; Ackelsberg and Yukl 1979; Eccles 1985; Grabski 1985; Watson and Baumler 1975). Transfer pricing provides one of the few environments where a bilateral monopoly (i.e., two negotiators who must agree with each other or disagree, since they can bargain with no one else) is directly relevant. Expanding the domain of the study to include outside alternatives and potentially uncertain futures expands its utility to more general negotiating contexts.

Many of the results fit the predictions of negotiation theory, including: (1) self-oriented (i.e., divisional) reward systems led to more disparate outcomes than more cooperative incentives; (2) firm profits increased with experience; (3) adding uncertainty to a divisional reward scheme increased conflict (some); (4) multi-period interactions with the same negotiator increased cooperation; and (5) the mixed incentive scheme led to the greatest frequency of neither advantageous nor integrative outcomes (see table 2).

The counter-intuitive, but predicted, result was that self-oriented, divisional reward schemes would maximize firm profits. To go further, the data clearly showed that the most profitable, integrative, and equal agreements occurred when neither party had market alternatives and they were working with divisional incentives. More generally, the two forces at work here appear to be high aspirations (wanting to do well for yourself) and equality (we both work for the same firm and neither of us has other options). The obvious conclusion in this situation is to promote internal competition among divisions while restricting the pursuit of profits outside the firm.

The study's puzzling result is the number of equal, high joint-outcome agreements

Table 2
Single Trial/Multiple Trial Transfer Pricing Negotiation Outcomes (Data from Chalos and Haka 1990)

Incentives Market Alternatives	*Completely Integrative*	*Almost Completely Integrative*	*Advantage to Player with the Market Alternative*	*Almost Advantage to Player with the Market Alternative*	*No Advantage Not Integrative Unequal*	*No Advantage Not Integrative Equal*	n
Division							
None	8/26	0/1	—	—	1/1	1/2	10/30
Uncertain	2/16	3/0	4/17	0/2	2/1	1/0	12/36
Certain	5/17	2/0	3/10	1/2	1/2	0/5	12/36
Mixed							
None	4/12	1/5	—	—	3/7	1/6	10/30
Uncertain	5/18	0/1	2/6	0/2	0/2	5/7	12/36
Certain	5/13	0/0	6/13	0/1	0/5	1/4	12/36

Note: The first number in each pair refers to the frequency of outcomes from single trial negotiations; the second number refers to outcome frequencies from multiple trial negotiations.

(81 of 192; 42 percent) when one party had a more valuable outside alternative (see table 2). Whether this result was due (1) to fear of revenge because the other party might have an outside alternative on the next round, or (2) to the establishment of a reciprocally cooperative behavior pattern is impossible to determine from the data. Results in a coalition bargaining context (Murnighan 1981) suggest that revenge is unlikely, as current bargaining demands can outweigh the desire to hurt a previous villain. Nevertheless, the expectation of potential revenge may be sufficient to cause people to be risk averse and not to exercise their short-run alternatives.

These studies are substantially different from the theoretical work on the principal-agent problem, as they constitute observed rather than assumed behavior. The next section explores how studies and theory from the negotiation literature might enrich the accounting environment.

Negotiator Rationality

Economic models of negotiation assume rationality and focus on outcomes that should emerge from rational action by both (all) parties. The most well-developed component of this school of thought is game theory, that is, the analysis of rational behavior in conflict situations. If economic models provided fully accurate descriptions of negotiation outcomes, empirical research would be unnecessary—behaviors could be simply deduced from theory. But numerous studies (Roth 1983) show that negotiator behavior differs from the predictions of game-theoretic models. Behavioral decision research also shows that people deviate from rationality in systematic and predictable ways (Kahneman and Tversky 1982; Dawes 1988; Nisbett and Ross 1982). More specific to the negotiation context, evidence shows that, despite the existence of an agreement zone, deviations from rationality in individual decisions lead to disagreements and Pareto-inefficient agreements (Bazerman 1990; Murnighan et al. 1990; Neale and Bazerman 1991). Indeed, game theorists have begun to incorporate these behavioral regularities in their analysis (e.g., Kreps et al. 1982).

Raiffa (1982) argues that rational models are insufficient for either understanding or prescription. He outlined an asymmetrically prescriptive/descriptive approach to negotiation, suggesting that advice to negotiators should depend on an understanding of the actual decision processes of the opponent, rather than assuming that the other party is fully rational. In contrast to mainstream economic and game-theoretic approaches (of which Raiffa was one of the early founders), he acknowledges that negotiator behavior may fall far short of rationality.

Raiffa's work marks a turning point in negotiation research for several reasons. First, he realized that accurate descriptions of negotiators are necessary for optimal prescriptions. Second, he noted that negotiators do not intuitively follow purely rational strategies. Most important, he initiated dialogue between prescriptive and descriptive models. His approach seeks prescriptive models that allow the focal negotiator to better anticipate the likely behavior of the opponent.

Recent research has addressed several negotiator departures from rationality. Building on behavioral decision making, research on two-party negotiations suggests that negotiators tend to (1) ignore the cognitions of others, (2) be overconfident, (3) escalate commitment, (4) assume that outcomes are fixed-sum and, therefore, overestimate the competitiveness of their negotiation, (5) overweight readily available information, and (6) be highly affected by the way their negotiation is framed (Bazerman and

Carroll 1987; Bazerman 1990; Neale and Northcraft 1990). Overall, this research has identified a variety of biases that create important limitations in a descriptive model of negotiation.

The Three Initial Scenarios

All three of the scenarios introduced at the beginning of this paper relate more closely to public rather than managerial accounting, an environment where negotiations are even more common. The first scenario not only highlights the principal-agent problem; it also places the accountant in the role of third party intervening in a complex negotiation between two disputants. Two conflicting parties have difficulty resolving their dispute. They tend to see the conflict as fixed-sum (Thompson and Hastie 1990) and, therefore, adopt highly competitive stances toward one another. A third party can provide a more objective point of view that recognizes the integrative potential in the relationship (Pruitt 1981) and can effectively buffer the interaction, deflecting unnecessary conflict and providing a structure where both parties can concede gracefully. In particular, a third party can suggest concessions to each party that are no longer identified as demands from the other party. The third party can also absorb any latent dissatisfaction following an agreement, allowing the parties to continue their interactions more amicably.

Research and theory on the behavior of third parties (e.g., Kressel and Pruitt 1985, 1990) has been increasingly prevalent in the negotiations literature. Work on third parties suggests that the outcomes of a dispute (both objective and subjective) are affected by: (1) its intensity (Thibaut and Walker 1975), with mediators being relatively ineffective in volatile disputes; (2) its structure (Sheppard 1984), with different third party mechanisms, including arbitration, mediation, and intervention (Murnighan 1986) having decidedly different effects; (3) perceptions of procedural justice (Folger 1986; Tyler and Lind 1988), which can drastically affect post-resolution attributions; and (4) the role assumed by the third party (Kolb and Sheppard 1985; Murnighan 1986), which can show a wide array of subtle variations, depending, in part, on his or her (a) self-interest, (b) concern for the disputants (Conlon et al. 1990), and (c) power (Kolb 1983; Murnighan 1986).

This wealth of literature on third parties presents a very different picture from the implications of principal-agent models, even though their domain of study is quite similar. In particular, the literature on third parties more explicitly includes the possibility of cooperation and mutually beneficial outcomes, even going so far as to work toward the establishment of a coordinated system of interaction between otherwise competitive disputants. Clearly, the underlying philosophy concerning basic human interaction is different in the two approaches. Research programs based on the two independent philosophies would miss the potential synergy from attending to both.

Scenario Two deals with the internal organizational problem of establishing independent work groups. Solomon (1987) noted in his review that much of the work of auditors is conducted by teams, although he emphasized dispersed groups whose interaction depends on written rather than interpersonal communication. Scenario Two describes more closely interacting accounting groups, necessitating research on more intense interactions. Indeed, we implicitly assume that many of the findings of research on such close groups would be relevant to dispersed groups; the converse is much less likely.

Recent studies suggest that the demographic similarities within a work group may be a critical determinant of its effectiveness. Even though research has only recently addressed the internal demography of interacting groups (e.g., O'Reilly et al. 1989), similar abilities and demographics may contribute to greater performance enhancement than technical diversity, even when creativity is valued (Ancona and Caldwell 1990; Murnighan and Conlon 1990). Combining these ideas with earlier work on coalitions (Ayres 1985; Murnighan 1978; Murnighan and Brass 1990) would provide the basis for a number of interesting hypotheses on interpersonal similarity, power, and ability—issues that would be particularly important for work groups in accounting and work groups in general.

Scenario Three presented a basic social dilemma (Dawes and Orbell 1981): how can a group police itself to act cooperatively in a competitive environment where short-term self-interest dominates? Research on dilemmas lay dormant in the 1970s but has reawakened in the 1980s. Studies have documented (1) the effectiveness of matching strategies (Axelrod 1984) and communication (Dawes et al. 1977); the voluntary use of sanctioning systems to reduce competitive behavior (Samuelson et al. 1984; Yamagishi 1986); the effects of asymmetric outcomes on the creativity of the parties' strategies (Murnighan et al. 1990); the effects of establishing a minimal contributing set to remove the dilemma and insure efficient cooperation (van der Kragt et al. 1983); and, of particular relevance to accounting contracts, the effects of the expected length of the interaction (Roth and Murnighan 1978). Research on social, prisoner's, and other related dilemmas (e.g., the Volunteer Dilemma; Murnighan and Metzger 1990) are establishing strong empirical and theoretical foundations that can be applied in a variety of contexts. Accounting environments provide a ready field for extensions of this research domain as well as applications from existing findings.

Conclusions

A common stand in the economic literature on negotiation is that rational models are the most comprehensive theory of decision making and, before throwing them out as descriptive models, we must present a replacement. In a Kuhnian (1970) sense, this prescription suggests that we are in the middle of a scientific revolution and that the rational model should remain until a legitimate successor emerges. We do not accept this argument. First, we do not expect a replacement theory to cover all of the myriad deficiencies of the rational model. In addition, any gains in the presentation of an overarching model would be more than offset by an inability to make specific predictions (e.g., March and Simon's 1958 concept of bounded rationality). Rather, current behavioral decision theory and research offers a set of adjustments to rational models that will improve their predictive power. A model that adjusts the basic rational model and incorporates known systematic biases better describes actual behavior than the rational model operating alone. One that incorporates the dynamics of negotiation within well-specified contexts (e.g., the environment of accounting) would be even more effective.

Where does this leave the future of accounting research on negotiation? We feel that several directions are clear. Prescription must be based on the actual decision processes of negotiators. Optimal advice cannot depend on rational models when we have ample evidence of less than rational behavior. Descriptive research should have an implicit model of rationality against which actual observation can be compared; it must combine theory and the particulars of the context to build an understanding of situations and their structure, which can then be reincorporated in the theory. Returning to the three scenarios that introduced this paper, we must identify the behaviors that can be expected from the actors in these contexts and identify how to use this understanding to improve the advice we might provide accountants and auditors. This research direction provides the potential to generate more appropriate theory, conduct more useful descriptive research, and improve the quality of negotiations in and beyond the accounting domain.

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A SPECIAL FEATURE[1]

Guest Editors: Yuji Ijiri and Shyam Sunder

Information Technologies and Organizations

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I. Information Overload and Organization Hierarchy

Q. What has been the impact of information technologies, especially of artificial intelligence, on organizations. In *The Sciences of the Artificial*, you described systems that are adapted to the goals and purposes imposed by their environment. Have information technologies enabled business and governmental organizations to grow bigger, become centralized, or change in other ways?

A. Information technologies have had a great impact on the way in which information is gathered and disseminated, but their impact on the structure of the organizations has been rather limited. Certainly, there has been a scale change in organizations. Business organizations of the size of General Motors, AT&T, or IBM were inconceivable a hundred years ago. But, was that because people didn't know how to create and run them, or because there wasn't any need for them? These are two different questions.

The political process has seen large changes due to mass communication. Television allows the President of the United States today to speak directly to most citizens in their living rooms. George Washington could not have done that 200 years ago. Faster communication has made it possible for us to create more unified organizations spread over vast distances. When Wellington was sent to Portugal to fight the French, he was in charge. A message might have taken a week or more to get to and from England. Today, he would be in constant communication with London. The Vietnam War was fought from Washington. There never was a unified field command. Thus, the responsibility and authority domains of Westmoreland and Wellington were drastically different.

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[1] **Editor's Note:** This article is based on an interview with Professor Simon conducted by **Yuji Ijiri** and **Shyam Sunder** on July 3, 1989. Professors Ijiri and Sunder, guest editors of *The Accounting Review* for this article, edited the transcript with the approval of Professor Simon.

Herbert A. Simon is the Richard King Mellon University Professor of Computer Science and Psychology at Carnegie Mellon University, where he has taught since 1949. For the past 30 years, he has been studying decision-making and problem-solving processes, using computers to simulate human thinking. He has published over 700 articles and 20 books and monographs that span the disciplines of economics, psychology, computer science, econometrics, management, organizational behavior, accounting, and administrative sciences.

Educated at the University of Chicago (Ph.D., 1943), he has been recognized by honorary degrees from a number of universities. He was elected to the National Academy of Sciences in 1967 and has received awards for his research from the American Psychological Association, the Association for Computing Machinery, the American Political Science Association, the American Economic Association, and the Institute of Electrical and Electronic Engineers. He received the Alfred Nobel Memorial Prize in Economics in 1978 and the National Medal of Science in 1986. He has been Chairman of the Board of Directors of the Social Science Research Council and of the Behavioral Science Division of the National Research Council, and has served as a member of the President's Science Advisory Committee.

The effects of this change have been disadvantageous as often as advantageous. Organizations have begun to relearn the lessons of decentralization: divisionalization allows large, multiproduct corporations to reduce the amount of entanglement and coordination. With modern communications, particularly the computer, we have changed the balance between the number of messages that can be produced and that can be received. At first we think of producing more information as a great thing, without thinking of what happens at the receiving end. Gradually, as we get more sophisticated, some of these differences may be reduced.

People have to be trained not to take in information just because it's there. It is a big social training job. Perhaps we ought to start in the first grade and give children practice in turning off the television, even turning it off the minute the news broadcast starts. From time to time I give lectures to executives about why it's dangerous to read the daily newspaper; they must realize that they don't have to pay attention to information just because it is available. No matter how much information becomes available, if you decide not to read it, this growth of information becomes irrelevant.

Why do we follow our everyday information strategies? We must know whether we are processing information because we expect to make a decision or because we enjoy doing so, like getting hooked on reading a serial or a detective story. Once we understand why we do what we do, we would make better decisions about what to read. We would realize that not knowing something is a great way of making our friends feel good telling us about it.

Let me illustrate why humans have to process information selectively. Since I decided to go to China this spring, I paid more attention to Chinese news than I normally do because I was intending to make some decisions on that basis. It turned out I made the wrong one in spite of the fact that I had the best available information Friday, June 2, 1989, directly by phone from Beijing. Alas, it wasn't Saturday's information. I arrived Monday, June 5, right after the Tiananmen Square massacre, though, fortunately, I got out of Beijing two days later.

So you can see where we must switch our priorities. Communication technology has certainly affected our organizations and society by increasing the amount of information explosively. But I don't think it is a large feature. I think the large feature is the limited ability of people to absorb information; the scarce resource is human attention, not information. That puts a tight constraint on how much information you can pour into a system. This was the main reason why management information systems were such a disappointment; they were designed to provide information without ever asking how much information could be absorbed, or what information was relevant.

Once we understand where the binding constraint is, we can understand why information technologies have had so little impact on the structure of organizations. In the *Sciences of the Artificial*, I tried to describe complex systems and explain why they are hierarchical and why we should not think of designing organizations so that everybody speaks to everybody. There are good reasons why we use nesting-block designs of units within units of organizations.

If we sit in any managerial position, we have a boss, some subordinates, and some other managers at our level. If we go down a level, we still have a boss above, some subordinates below, and some people at our level. So in a certain sense the job of running an organization doesn't change as a function of how many levels there are. Similarly, if you look at the armed forces of World War I or II, you had divisions, corps above them, then armies, which constituted army groups. Each one of those commanders was playing with three chess pieces—his left wing, his right wing, and his reserve. Then each of the commanders of those units had three chess pieces, and so on.

Hierarchy was a great invention—and it is much older than just a couple of hundred years. Modularizing organizations enables us to operate on almost any scale; the same module design can fit at different levels of the hierarchy. This fundamental structure of organizations has remained unaltered by the development of information technologies.

II. Noneconomic Inducements and the Docility Mechanism

Q. There seem to be two streams in institutional literature—the evolutionary perspective and the design perspective. How would you view the relative importance of each? In designing an organization, your theory on inducements and contributions plays an important role. Agency theory is its direct descendant. Although incentives lie at the heart of economic theory of organizations, greed is said to weaken or even destroy modern business organizations. How would you assess the needed balance between inducements and contributions?

A. In a certain sense organizations are designed: their behavior is carried out by human beings who think they are acting intentionally and purposively. However, they are not necessarily designed in the sense that the consequences of these actions have been thought through. Organizations constantly adapt to changing circumstances, and informal practices develop without being consciously set as policies. The interesting question is how well the managers keep informed about how the organization really operates so that they can design it. You can design an organization only to the extent that you know the environment in which it operates, and how it really operates.

Organizations are continually having new experiences with their changing environments. They're also continually sensing new consequences of what they're doing. Design is important to the extent that people are aware of that and try to do something about it. So, design is one of the mechanisms in organizational evolution.

In Darwinian evolution the only mechanism you have is random change, which either is or isn't adaptive. If it increases fitness, the change survives; otherwise, it doesn't. In organizations, such random adaptive processes may occur occasionally, but we can also have a conscious decision that certain things contribute to survival and other things don't and, thus, deliberately affect modification of the system.

What might look like an evolution at the higher or macro level of a system may look like a design to those who are doing the adaptation at the micro levels. At lower or micro levels, somebody is making very conscious decisions to adjust the system. If you give someone discretion, he or she exercises it. That may include some very deliberate design decisions.

In a highly simplified form, the inducements and contributions approach asserts that an organization will work only if we motivate all individuals whose behavior is essential for its maintenance—customers, shareholders, the employees, etc. The problem I have with the agency theory interpretation of the inducement-contributions balance idea is that this theory seems to look almost entirely at economic inducements. This theory also seems to assume that leisure is such a desirable good that people are intrinsically shirkers and that they will only do what can be enforced.

There is a tremendous amount of psychological evidence that contradicts this: human beings are not only capable of acquiring strong loyalties to organizations or organizational units, they are incapable of not acquiring them. We must look at loyalty structures to learn what ties people to organizations. (I prefer to call them "identification structures" because they have a strong cognitive component as well as a motivational component.)

People do all sorts of things for which they receive no reward. They don't just do the minimum they can do without getting caught. We often find people who are enthused for an organization. I'd feel happier about the agency literature if the people who are writing it understood the centrality of the *identification mechanism.*

This relates to your question about greed, because it suggests that there is a big nongreed component in human behavior. If you were interested in evolutionary theory, you may ask "why don't the greedy ones outbreed the nongreedy ones?" There is a very good answer to that.

In social species like ours, a person born with nothing but greedy genes would be unable to receive all the benefits that society can bestow in the way of influence and instruction. In contrast, a person born with a few docility genes—that is, with the willingness to accept instruction, influence, information, and persuasion from the social environment—has a great advantage. If you build a mathematical model of human behavior, you will find it very difficult to reconcile fitness with altruism without something like the docility mechanism.

Society can use docility, within limits, to influence the person to be nongreedy. Being loyal to an organization is a form of being nongreedy. In a social animal like the human being, you would expect to see a strong component of docility, by which I mean acceptance of social influence. You would also expect the society to gradually learn how to use this trait to produce people with very strong organizational loyalties. In fact, it takes more than contracts and economic rewards to make an organization work. There is no better way of having a work stoppage in an organization than for everybody to do exactly what their contract calls for, no less and no more. Work-to-rule is a euphemism for work slowdown.

Maybe there is a reason why people other than economists use the word greed for the narrow subset of motives that economists analyze. Noneconomists can see that they and others respond to other motivations. Therefore, they may think that a person is a kind of a monster if he responds only to the motivations that economists talk about.

III. Privacy and Control

Q. Computers have changed the activities of accountants and auditors considerably over the past two decades. What is your assessment of the impact of information technologies on accounting and control? In particular, are we heading toward the state of "overcontrol?" Has there been a change in the functions of controllers? Would artificial intelligence play an important role in accounting in the future?

A. I share a concern about any data bases, computerized or not, recording private information, and how those are managed, who manages them, what controls are placed over their use. One of the early people who were sensitive about privacy, Westin, wrote some books on privacy that were a bit scary.[2] He was recently quoted to the effect that he had been overalarmed. Fortunately, there are some countervailing tendencies here.

As we have built up computerized record systems—as distinguished from the disorderly scraps of paper people used to keep—we also have tended to formalize the rules for using them. Somebody in Cleveland, or somewhere else, used to keep little pieces of paper about my credit-worthiness. I had absolutely no control over their quality or use. As these systems are computerized, you can place controls over their quality and access. As soon as we have a computerized system, we can take up privacy and information security as a technological problem.

The first-order issue in dealing with the impact of information technologies is not privacy and control but information overload. Therefore, in designing information systems, we should start with the needs of information users, not of information producers. How many organizations do you know where the actual decision-making process has been studied to find out what kinds of information would be relevant as a basis for designing their information system?

On the functions of controllers, I don't know whether we have progressed in our ability to provide the needed data. Our study of the functions of controllers in the mid-fifties indicated that managers wanted a cost accounting system that really showed them the causes and effects.[3] In other words, they wanted to separate those things over which they had control from those they didn't control. Are we much wiser now about that aspect today than we were then?

One of the main recommendations of our early study on controllership was that the controller should act as a service organization for the operating units. Less emphasis should be placed on periodic reports and more on special studies and economic analyses for operating people. Perhaps operations research ideas have gotten into controllership since that time and perhaps there is a greater emphasis today on conducting such analyses. Controllers should think beyond the traditional domain of providing accounting data and designing financial reports. How many companies have a good system for selectively filtering industry and world news for use by executives? Do many companies bring in the *New York Times* or *The Wall Street Journal* in computer readable form so managers can consult these sources on demand, without being force-fed?

On the issue of artificial intelligence (AI), I think there is a lot of potential. People have been writing about the disappearance of middle managers for quite a while. Middle managers' functions have changed a great deal—fewer line managers and more staff—and I think that will continue. I hope that more AI enters into information systems because that's the only way that the output of information systems can be sufficiently filtered for human processing limits. Such use of artificial intelligence is already in place for many functions, but there is much unexploited potential.

In the fifties, accounting systems started flagging items with unusual variances. You may call it artificial intelligence—a system knows what is an exceptional value and calls it to somebody's attention. Computer systems can take over many more such tasks if we can get rid of our compulsion to have everything scanned by the human senses. Going beyond just highlighting exceptional items, computers can also do analyses.

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[2] Alan F. Westin. 1967. *Privacy and Freedom*. New York: Atheneum.

[3] Herbert A. Simon et al. 1978. *Centralization vs. Decentralization in Organizing the Controller's Department: A Research Study and Report.* Republished by Birmingham, MI: Scholars Book Co.

However, I don't think that the basic framework of organizations will be altered by the introduction of artificial intelligence. None of the technological developments I've seen really strike at the heart of organizational structure, or require organizations to be turned upside down.

IV. Research and Instructional Technologies

Q. Would information technologies impact research and education critically? If so, in what way; if not, why not? In particular, we wish to have your comments on the availability of computers and databases on research, computer-aided instructions, and on a possible shift in emphasis away from skill training.

A. Information technologies have certainly affected the way in which research is conducted. All sciences are influenced by what instruments are available. Physicists wouldn't be doing the things they do without accelerators. Scientists can, however, ask themselves what kinds of instruments they would like to have. Publicly available sources of data may shift researchers' attention toward macro-level issues that can be addressed using such data. It may further postpone giving detailed attention to areas in economics where I think looking needs to be done—the details of decision-making processes in organizations. Such data are not as readily available. One has to go into organizations and conduct intensive studies.

Availability of public data banks tends to pull people away from facing up to that ultimate necessity of looking closely at decision-making processes. But beyond that, I always prefer theories that are based on data over theories that are not; we have enough of the latter in economics and allied fields.

I don't know what has been done in experimental accounting, but if it is related to experimental economics, it is a very useful development. Of course, you could run it, like any other research method, into the ground. Life is more comfortable for most of us if there is a procedure to tell us what to do next. Every science is subject to the ever present danger of turning into mindless, automatic science—compute a *t*-statistic and a chi-square statistic, and then you're done!

I don't know whether the availability of computers and databases has increased that danger. People who were determined to compute chi-squares before with desk calculators, or by hand, ended up doing it anyway. There is no doubt that computers are used for data dredging. The key question is whether a larger fraction of the scientific community's time is spent on doing this. Some scientists used to spend a large fraction of their day doing it because manual computation took so long. Now they may spend a large fraction of their day doing it because computers make it so easy to try out many different computations. What you have to fight for continually is that at least some people spend some of their time thinking.

Computers certainly changed the way in which research problems are formulated and solved. We can learn things about the behavior of complex systems by computation without closed form analytic solutions. We also know its limits: computation generally yields the solution for a particular set of boundary conditions. If you want to discover more general results, you have to run many different conditions. Therefore, whenever it is feasible, we still prefer to do things analytically.

Even analysis can increasingly be done by symbolic manipulation programs. But now we have this second tool that we can use for problems where there is no reason to think that we could ever solve them analytically. I have a distinguished friend in theoretical mechanics at California Institute of Technology who for years solved partial differential equations involving infinite slits in steel plates. Why infinite? So he could handle the boundary conditions. After resisting it for many years, he now combines analytical results with computer simulations of plates with bounded slits. He lives happily in both worlds now, as we all must do.

AI experiments, like others, only inform us about a specific case; an experiment does not have variables in it, only instantiations of variables. Artificial intelligence, too, is an experimental science. I don't share the enthusiasm of some formalists in statistics, economics, and mathematics who believe you can learn everything by sitting in an armchair and thinking deeply. I believe that human beings got to know most of the things they know by looking and touching and smelling; and running a computer is one way of looking and touching and smelling.

Finally, theorizing itself can also be helped by the computer. I have three examples of the work done at Carnegie Mellon in this regard. First, the set of programs that we described in our book *Scientific Discovery*.[4] These programs take data and find theories, and they do it very efficiently. They do in two minutes what took Kepler 20 years. Bacon, Glauber, and other programs belong to this category. Second, the impressive program Deepak Kulkarni wrote as a part of his thesis last year designs strategies for sequences of experiments, using what it finds in each experiment to plan the next one.[5] Third, in Professor Jonathan S. Lindsey's laboratory in the Chemistry Department, experiments are conducted automatically. A lazy Susan full of tubes filled with liquids goes round and round, adding things, boiling them, and performing other operations that chemists do, taking measurements along the way. A doctoral student is now planning to add a program that will try to analyze the results and draw inferences from what happens in those pots. Similar work is being done in many other places.

Now let me turn to education. The impact of information technologies on classroom instructions has been much slower compared with other fields. Two things have contributed to this: the high cost of preparing and updating instructional materials and the students' expectation that they deserve personal attention in the form of lectures in exchange for the tuition they pay. There is, however, one aspect in which the technology is lacking. When we talk about reforming education, we talk about the curriculum as experts on subject matters, and not as experts on learning, because few of us are experts on learning. If we could discover the fundamental principles of human learning, as we are just beginning to, it could change the way we write and teach.

Aside from instructional technologies, computers have caused a significant shift in emphasis away from skill training. A case can still be made for skill training on a sampling basis. Skill training has always been on a sampling basis—except that we never admitted it—and now we can narrow the coverage by reducing the sample sizes. The instructor can teach the skill by going through example A but not doing the same for examples B, C, D, E, F, G, and H. How do we teach integral calculus now? I assume we spend less time getting people to memorize or guess the integrals of various sets of functions. But we probably still want to sample that. Pick some area in accounting, for example, have students understand it, and spend the rest of the time learning the underlying principles.

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[4] Pat Langley, Jan Zytkow, Herbert A. Simon, and Gary L. Bradshaw. 1987. *Scientific Discovery: Computational Explorations of the Creative Processes*. Cambridge: MA: MIT Press.

[5] Deepak S. Kulkarni. 1988. "The Processes of Scientific Research: The Strategy of Experimentation." Carnegie Mellon University Computer Science Department Paper CM-CS-88-207.

I hope someday we'll learn that curriculum building is a process of sampling. We sometimes get so wound up thinking that there are things that have to be covered. There are a million things that have to be covered and there is no way that more than a hundred of them are going to be covered. So we might just as well recognize that we are sampling.

V. Artificial Intelligence and Artificial Ethics

Q. How might the goals of educational institutions change because of technology? The need for teaching technical matters seems to be on a declining trend now that such matters can be better handled by computers. Would all of this change the philosophy of what education is all about? Do you think that there will still be the core of knowledge about human beings, such as ethics and the emotive side of human beings, that must be taught by human instructors? Should educational institutions focus on such matters only, delegating technical instructions to various training machinery?

A. I still think that students are going to be taught by human instructors. Anybody with tenacity can educate himself or herself in almost any subject, but it isn't necessarily efficient. Most realizable artificial intelligence in the near future will be focused on fairly concrete things. Expert systems, for example, do best when there are a zillion specific pieces of knowledge for which they can act as a big recognition memory. That's why legal retrieval and medical diagnosis systems have been effective. Expert systems are still not very good at reasoning about fuzzy things. That's not a permanent limit, but it will guide the division of labor between machines and people for a long time to come.

There are some interesting questions about whether you can teach ethics at all. Let's suppose that you can. A large part of the teaching of ethics consists in taking situations or actions and showing that they have many unanticipated consequences and side effects that people don't immediately think about. Frequently, awareness of such effects is the locus of the ethical component in the decision. An effective course in ethics would make simple choices in life seem more complicated.

The aim of a course in ethics is not to change peoples' values. A course on ethics has to make students think about the multitudinous frames of reference and consequences of decisions before they decide something. Take abortion—a good issue to teach ethics to undergraduates in our country today. Some people say right-to-choose and others say right-to-life, as though either of these slogans can settle the issue. The first step in teaching ethics is to show that there are many ways to look at that issue and most of them are quite complicated. Whether thinking of these complexities leads them to favor one side of the issue or the other is another question.

What should be the goals of courses in ethics? To say that the goal is to produce more ethical behavior is to beg the question. By their nature, ethical problems involve conflicts of values. Unless you know what the right values are, how can you judge whether people become more ethical after taking the course? Instead, we may judge an ethics course by whether people become more thoughtful. We might be able to teach that.

I take it that most people who go to business school have a fairly strong motivation to get rich. Over the course of their lives our students will have various opportunities to get rich, or to think they are going to get rich. Are they going to behave ethically? We can teach them to be aware of when they may be behaving unethically. There is little we can do if they choose what they realize is unethical behavior. But at least we should make sure that students are aware of some values other than the value of getting rich.

Being boundedly rational, we see things only partially. You can, therefore, powerfully affect peoples' views on a question by focusing their attention on a particular aspect. World politics might be different if, before a war could be declared, you had to play three hours of battlefield scenes, at the ground level, complete with corpses. It is easy to declare war if you count beans instead of thinking of real people who bleed. Teaching ethics goes beyond just making people aware of the consequences: it makes them aware of associations in their minds so that they can't think of A without thinking of B.

The humanities claim to be the guardians of human values, and the liberal education in the past has included a strong humanistic core. But, humanities don't know; they feel. If I wanted to understand what the Stalin era trials were about, I would rather study a novel, *Darkness at Noon* by Arthur Koestler, than a social science study. Koestler gives a marvelous description, and it is a great way to teach. Not only does he make you feel it, but he had the facts right. People do learn different things with hot cognition than they learn with cold cognition. Perhaps we ought to be teaching ethics hot and not cold, provided that we get the facts right. Effective cases are the ones in which you are torn inside. I've never had a moral choice in my life unless I am in internal conflict, not just an intellectual conflict. Ethical questions are the ones where your left side says one thing and your right side says the other.

Going beyond artificial intelligence, I think we have "artificial ethics" all over the place today. Every time a computer makes a decision, for example, who gets an American Express card, it is implementing a set of goals or values. If you could prove that some of their discriminant functions built to make the credit decision are prejudicial to minority groups, they can go to court and sue. As computers get into more problematic decision areas—medical diagnosis, cancer treatment—you won't be happy with a program unless you are satisfied with the balance of values that is implemented by the program. For example, when I land at an airport, I would like to be landed by automatic landing devices. Here are two reasons. I believe these devices are designed with the aim of getting planes down safely (I won't trust them otherwise), and I believe that by now they are perhaps technically better than pilots. I accept them because of the right values and the right technology. We already have artificial ethics in this sense.

I believe that the current work in AI and cognitive science are yielding, for the first time, a deep understanding of how the human mind works and, hence, a deeper understanding than we ever had into human nature. Cognitive science has been especially important, though it interacts closely with the other sciences. I can't help but believe that gaining a deeper understanding of ourselves has to have, in the long run, very profound effects on society. But I'm not sure I can go very far beyond that fuzzy picture.

Will those effects be good or bad? I have to fall back on an even weaker position. On average and on the whole, is it better to know than to be ignorant? That's a prejudicial way to state it, since we know that the real problems in the world today are ourselves. I guess we are going to solve that problem only if we know ourselves better. If we are that voracious species on the earth that is stamping out everything else, we better understand that species.

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NOTES

A Test of Audit Deterrent to Financial Reporting Irregularities Using the Randomized Response Technique

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SYNOPSIS: This study describes an experiment that examines the effects of managers' perceptions of internal and external auditing on the potential commission of financial reporting irregularities. An earlier study by Uecker et al. (1981) examined the impact of auditor aggressiveness on auditee behavior. By introducing a no-audit condition into the experimental design, this study addresses the fundamental issue of whether the *existence* of internal and external auditing affects auditee behavior. The study also tests whether the deterrence effects of internal and external auditing are similar.

Rather than directly eliciting responses from subjects, this experiment used the quantitative randomized response technique. This method is designed to assure subjects of anonymity and thereby obtain truthful responses to sensitive questions. A total of 264 subjects, the vast majority of whom were experienced managers, made decisions on three cases involving financial reporting issues. The first case, involving a potential write-off of a loan made to a key company officer, was virtually identical to that of

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Uecker et al. (1981). The second case involved a writedown of inventory to the lower of cost or market. The third case involved an accrual of an invoice for services rendered prior to closing the books. These cases varied several factors expected to impact on the effectiveness of auditing as a deterrent. The factors were: materiality, type of irregularity, perceived extent of GAAP violation, and incentives for misstating income. The decisions were made in a situation in which there was either no auditing at all, only internal auditing, or only external auditing.

The results clearly supported internal and external auditing as deterrents to financial reporting irregularities when all of the following four conditions were present: material dollar amounts, irregularities involving asset overstatements, unambiguous GAAP violations, and less incentive for misstating income. However, the deterrent effects cannot be attributed to any one of the conditions. Also, the internal auditing effects were similar to those of external auditing.

Key Words: *Auditing, Deterrence, Irregularities, Randomized Response Technique.*

Data Availability: *Data relating to this study are available from the authors upon request.*

IN this study we provide evidence on managers' perceptions of the extent to which internal and external auditing are deterrents to financial reporting irregularities. We accomplish this through a behavioral experiment using treatments in which there is no audit versus treatments in which there is either internal or external auditing. This experiment builds on Uecker et al. (1981), who obtained counterintuitive results that auditor aggressiveness had no deterrent effect on financial reporting irregularities. Our introduction of a no-audit treatment enables us to answer the fundamental question of the *existence* of a deterrence effect.

Because our experiment asks sensitive questions about the integrity of subjects, we used the randomized response technique (Buchman and Tracy 1982; Buchman 1983; Berry et al. 1987) described in section II. Our results show that auditing is a deterrent to financial reporting irregularities for one of the three cases presented to the subjects. Also, the internal auditing effects did not differ from those of external auditing.

Section I discusses the prior literature relating to the deterrence effect of auditing. In section II the randomized response technique is discussed and the experiment is described. Section III provides an analysis and interpretation of results, and section IV contains concluding remarks.

I. Prior Evidence

The deterrent role of internal and external auditing with respect to financial reporting irregularities has received considerable attention for more than a decade. The Foreign Corrupt Practices Act of 1977 and the National Commission on Fraudulent Financial Reporting (the Treadway Commission) placed greater emphasis on auditors' responsibility to detect and prevent financial reporting irregularities. Also, standards of due care for external auditors with respect to irregularities have become increasingly demanding. Whereas Statement on Auditing Standards (SAS) No. 1 (AICPA 1972, secs. 110.05–.08) merely required the auditor to be aware of the possibility of irregularities, SAS No. 16 required the auditor to search for irregularities (AICPA 1977, sec. 327.05). SAS No. 53 mandated that the auditor design audits to provide "reasonable assurance" of detecting irregularities (AICPA 1988, par. 5).

As these authoritative pronouncements have evolved, both analytical and empirical studies have examined the deterrent effect of auditing. Ijiri and Kaplan (1971) proposed an analytical audit sampling model to generate "preventive" sampling. Recently, strategic auditing models used game theory to model the anticipatory (i.e., deterrence) effect of auditing (Graetz et al. 1986; Fellingham and Newman 1985; Anderson and Young 1988).

Turning to the empirical research, Churchill and Cooper (1964, 262) investigated the effect of auditing on the decisions of subjects in the search for the source of contamination in a large water supply system. They found that anticipation of an audit produced behavioral effects "toward conformance patterns in which the behavior of those who were audited tended to move toward the auditor's criteria." Barefield (1975) found that the frequency of audits did not produce statistically significant effects on the quality of auditee adherence to prescribed internal control procedures. In a study not involving accounting irregularities, Churchill et al. (1982) found that both audit anticipation and audit occurrence had significant effects in bringing down length of patient stay in hospitals.

An empirical study that focused on financial reporting irregularities was conducted by Uecker et al. (1981). It consisted of an experiment in which managers in business and industry were given information about a hypothetical company and were asked to assume the role of the company's president. Included in the information were descriptions of the company's internal and external auditors. Each was described in terms of either high or low aggressiveness. Uecker et al. found that the level of aggressiveness of internal and external auditors had no effect on any of the three decisions made by the subjects (one of which was a financial reporting decision). Mean responses given by the subjects indicated to Uecker et al. that "the managers did not attempt to overstate NIBT [net income before tax] materially" (1981, 474). However, approximately one-third of the subjects overstated NIBT materially, and that proportion did not differ significantly across treatments.

Since Uecker et al. were interested in levels of aggressiveness in auditing, they did not use a "no-audit" condition. We incorporate a zero-audit treatment to obtain a base-rate response. Investigating some level of auditing in comparison with the zero audit treatment allows us to say something about the deterrent effect of auditing per se.

Another difference between our study and that of Uecker et al. is that we used the randomized response technique in eliciting subjects' responses to sensitive questions. Although the subjects in Uecker et al. were assured of anonymity in a letter from their employers, it is not possible to assess the truthfulness of the responses. Most studies that have compared the randomized response technique to the traditional direct response elicitation (e.g., Fidler and Kleinknecht 1977; Tracy and Fox 1981) have found that the randomized response technique reduces response bias and induces more reporting of behavior that could be perceived unfavorably.

In the cases developed for our experiment, we varied several factors expected to impact on the effectiveness of auditing as a deterrent. The first factor is materiality, which increases the likelihood that the auditor will investigate. The second factor we varied is the type of irregularity involved. Generally, unrecorded liabilities are more difficult for auditors to detect than overstated assets (Robertson and Davis 1985). We expected subjects to perceive auditing to be more of a deterrent when assets are overstated than when liabilities are unrecorded. The third factor is the extent of a GAAP violation. An ambiguity about GAAP violation gives rise to ambiguity about the auditor's concern. Since an ambiguous GAAP violation would be easier to defend than a clear GAAP violation, auditing would be viewed as less of a deterrent. The last factor we varied was the incentive for misstating income. As these incentives increase, auditing would be expected to have less of a deterrent effect. The operationalization and combinations of these four factors are explained in the following section.

II. Experimental Method

Subjects

The 264 subjects were experienced managers in various organizations; only 14 percent of the subjects were full-time MBA students and most of them had previous work experience. Table 1 presents various demographic descriptive statistics about subjects.[1] As shown in table 1, the subjects represent a cross-section of professions, all possessing at least bachelor's degrees, have a median age of 36.5 years, and a median of 13 years of professional experience. The vast majority (71.5 percent) has had professional contact with auditors, and 10.8 percent were auditors in prior work.

The method of data collection varied. We obtained the cooperation of subjects through MBA classes, executive MBA classes, corporate training seminars, and business school alumni lists. It was necessary to use multiple sources because of the large subject pool needed to implement the randomized response technique. Most of the data were collected by mail. Overall, we obtained a 60 percent response rate.[2] In section III, we present evidence that the data collection method is not a confounding factor and that there is no evidence of nonresponse bias.

The Task

The task is similar to that in Uecker et al.[3] Subjects were told that they were to assume the role of the president of a hypothetical closely held, medium-sized manufacturer. They were informed about the importance of achieving a target net income before taxes (NIBT) of $740,000 and that doing so would result in a $20,000 bonus to the president.[4] Subjects were assigned to one of three treatments: (1) their company had no

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[1] Responses were received from 264 subjects, though not all provided complete demographic data.

[2] Of the 264 responses received, 85 were collected in person (100 percent response rate) and 179 were received through the mail (50.4 percent response rate).

[3] We did not, however, use an in-basket technique, where managers are provided with facsimile memoranda, much as they could expect to find in their own in-baskets. Because of the number of subjects needed and their time constraints, it was necessary to use the standard approach of providing limited information using a questionnaire.

[4] Subjects were told that the projected NIBT for the current year was $755,000, without considering the information presented in the cases described later. Our use of a hypothetical bonus is of questionable effectiveness as an incentive. We chose to include it because it was employed in the Uecker et al. study.

Table 1
Demographic Data

	Number	Percent
Specialization		
Accounting & Finance	60	23.3
Sales/Marketing	70	27.1
Engineering	57	22.1
Other	71	27.5
	258	100.0
Degrees Attained		
Bachelor's	102	38.9
Master's & Ph.D.	160	61.1
	262	100.0
Amount of Experience		
5 years or less	61	23.8
6–10 years	39	15.2
11–15 years	56	21.9
Over 15 years	100	39.1
	256	100.0
Age of Subjects		
Below 30	77	29.4
31–40	111	42.4
Over 40	74	28.2
	262	100.0
Auditor Contact		
Have had contact as part of work experience	183	71.5
Have not had contact as part of work experience	73	28.5
	256	100.0
Former Auditors		
Have been an auditor	28	10.8
Have never been an auditor	231	89.2
	259	100.0

audit (NA group); (2) an internal audit was to be conducted by a competent staff (IA group); or (3) an external audit was to be conducted by a competent auditor (EA group).[5]

Subjects were then asked to provide answers to three independent short cases. All groups were given the same three cases which involved financial reporting issues.[6] Case 1 was virtually identical to that in Uecker et al. (1981). The case portrayed a $50,000 loan made to a company officer as only partially collectible and subjects were informed that GAAP requires uncollectible loans to be written off as losses. Besides the bonus incentive, this case provided additional incentives for subjects to overstate NIBT. These consist of a recommendation from the executive vice president to grant an extension on the loan because of the officer's importance to the company's marketing effort, and a prediction that, if no extension were granted, the officer would be forced to default and would accept a position with a competing company. These incentives to extend the loan not only create further motivation to overstate NIBT but may cause subjects to believe that no write-off would be necessary if the extension were granted. Thus, subjects might perceive that they could avoid violating GAAP by deciding to grant the extension[7] and auditing would not be expected to have an effect.

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[5] The IA treatment was described as follows:

> Assume that XYZ Mfg. Inc. has an internal audit staff. Although they are primarily charged with auditing the financial statements, they are also performing operational auditing (e.g., compliance with company policy, fraud detection, and operational efficiency). You are familiar with the internal auditors'

Case 2 involved a writedown of obsolete inventory that had cost $100,000. The case provided an estimated range of the market value and informed the subjects that GAAP requires inventory to be reported at the lower of cost or market value. This case presents an unambiguous potential GAAP violation, simplifies the incentive for NIBT overstatement (i.e., by having the bonus as the only incentive), and has a higher dollar amount.

The cases described above involved potential overstatements of assets. Since unrecorded liabilities may be perceived as more difficult for auditors to detect than overstated assets, we developed Case 3, which involved the accrual of a $20,000 invoice received at year end. Although subjects were instructed that GAAP requires the expense to be accrued in the current year, they were also informed that there was reason to believe the invoice contained an overcharge. Because part of the invoice was in dispute, subjects could feel that whatever amounts they would accrue would not violate GAAP. Thus, Case 3 did not involve a clear-cut potential financial reporting irregularity.

We varied the dollar amount of assets or liabilities (and the related potential expenses and losses) involved in the three cases[8] to see if materiality is a factor. The magnitude of overstatement possible in our Case 1 is in the vicinity of 5.6 percent of NIBT.[9] For Cases 2 and 3, the magnitudes are 10.2 percent and 2.3 percent, respectively. Thus,

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> work through dealing with them the past two years. Your impression is that they are very competent and extremely aggressive. They appear to be thorough in their work and strict about documentary evidence and substantiation of statements made by XYZ personnel.

Virtually identical wording was used to describe the EA treatment. Uecker et al. (1981) used more specific details to describe the perceived aggressiveness of auditing. Unlike Uecker et al., we do not manipulate different levels of perceived aggressiveness and, hence, we use simpler descriptions.

[6] This study was conducted in conjunction with another study that dealt with nonaccounting irregularities. After these three cases were administered, two additional cases involving nonaccounting irregularities were presented to the subjects. Descriptions of these cases are available from the authors.

[7] Indeed, using a supplemental dichotomous randomized response analysis discussed later in the paper, we found that all three treatment groups for Case 1 (when compared to the other cases where we did not have the extra motivation) had the highest estimated percentage of subjects who overstated NIBT and the highest estimated percentage of subjects who would have attained the bonus.

[8] While we varied the dollar amounts across the three cases, we did not vary them within cases. Thus, all subjects were given the same dollar amount for each particular case.

[9] This is computed as follows: $[0.80(50{,}000)]/[755{,}000-(0.80)(50{,}000)]$. A review of empirical research on materiality judgments (see Holstrum and Messier 1982) indicates that approximately five percent of earnings seems to be a commonly employed materiality threshold.

Table 2
Factors That Vary for the Three Cases

Factor	Case 1	Case 2	Case 3
Materiality	5.6%	10.2%	2.3%
Type of irregularity	Asset Overstatement Understatement	Asset Overstatement	Liability
Perceived extent of GAAP violation	Ambiguous	Clear	Ambiguous
Incentives for misstating income	Bonus & Others	Bonus Only	Bonus Only

by materiality measures of prior materiality research, one case involves material amounts (Case 2), another involves immaterial amounts (Case 3), and a third case involves marginally material amounts (Case 1).

In each of the three cases, the amount of expense or loss reported potentially affected the receipt of the bonus. By strictly adhering to GAAP, the bonus would be forfeited in all three cases.[10]

Our experiment can be represented as a mixed design with one independent variable, at three levels, manipulated on a within-subjects basis (i.e., the three cases), and another independent variable, with three levels, manipulated on a between-subjects basis (i.e., the three audit treatments). The three case levels are defined by combinations of four different factors that are displayed in table 2. Since each of these factors potentially affects subjects' perceptions of auditing as a deterrent (as was discussed earlier), the three cases can describe varying degrees of these perceptions. Specifically, auditing should be perceived as the strongest deterrent for Case 2, because (1) it has the highest materiality, (2) it is an easier type of irregularity to detect, (3) it involves an unambiguous GAAP violation, and (4) it offers the least incentive to misstate income. Case 3 would probably be perceived as having the weakest deterrent conditions since it has the lowest materiality, the more difficult type of irregularity to detect, and the ambiguous GAAP violation. Although Case 1 offers more incentive to misstate income than does Case 3, manipulation of the incentives to misstate income were of questionable effectiveness (see section IV).[11]

Randomized Response Technique

The randomized response technique (Warner 1965) is a process of obtaining responses to sensitive questions that assures a subject of anonymity. The subject is instructed to respond to either a sensitive question or an unrelated innocuous question, depending on the outcome of a randomizing process (e.g., a coin flip) controlled by the subject. The subject performs the randomization in private and the outcome is not revealed to the researcher. Although there is no way for the researcher to know which question an individual subject has answered, one can obtain an unbiased estimate of the mean response to the sensitive question.

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[10] See Healy (1985) for evidence that financial reporting is affected by bonus contracts.

[11] Had we asked subjects afterwards to rate the cases in terms of deterrence perceptions, they could have read this before providing responses to the three cases or they could have gone back and changed their responses to the cases. Thus, a manipulation check would have risked a demand effect.

Three accounting studies have used the dichotomous randomized response technique in investigating the issue of false sign-offs by auditors. Considerable sensitivity clearly is involved in asking an auditor if he or she has ever signed off as having performed an audit procedure that actually has not been performed. Buchman and Tracy (1982) used external auditors as subjects, Buchman (1983) used internal auditors, and Berry et al. (1987) used governmental auditors. All three studies found evidence of false sign-offs. Furthermore, in Buchman and Tracy (1982), the randomized response technique was tested against a conventional (direct) response mode, and the authors found that the former produced more negative, self-implicating answers to sensitive questions.

Our use of the randomized response technique differs from previous accounting studies in two respects. First, we use the technique to address a different issue—whether the presence of auditing acts as a deterrent to the commission of financial reporting irregularities. Like false sign-offs, this issue involves sensitive questions and, thus, using the randomized response technique is appropriate. Second, we use the quantitative randomized response technique to obtain responses involving dollar amounts. Prior accounting studies used the dichotomous randomized response technique. YES or NO responses were used to estimate the true proportion of auditors engaging in false sign-offs. The quantitative randomized response technique allows for a numerical response, which does not limit researchers to investigating issues that require only YES/NO responses. This method, which was developed by Greenberg et al. (1971), involves a more complex experimental design and statistical analyses. The relevant aspects are described later in this article.

According to Greenberg et al. (1971), an overriding criterion for the choice of innocuous questions is that the dispersion of the innocuous question responses be at least as large as the dispersion of the sensitive question responses. If this condition is not satisfied, subjects might be reluctant to give responses indicative that they were answering the sensitive question. Our choice of innocuous questions satisfied this criterion (details are reported in section III).

Greenberg et al. (1971) also suggest the aggregation of two samples—one sample (sample 1) having a probability p_1 of answering the sensitive question, and the other sample (sample 2) having a probability p_2 of answering the sensitive question. Consistent with the use of the randomized response technique in the accounting studies reported previously,[12] we chose $p_1=0.70$ and $p_2=0.30$. Thus, for respondents in sample 1, if the last digit in the serial number of their own dollar bill was between zero and six (inclusive), they were asked to answer the sensitive question in Case 1; otherwise, they would answer the innocuous question. The same procedure was used for Cases 2 and 3 by examining other digits of the serial number. Thus, in each case, sample 1 subjects had a 70 percent chance of answering the sensitive question. Sample 2 subjects were instructed to answer the sensitive questions if the serial numbers were between seven and nine (inclusive); otherwise, they would answer the innocuous question. Hence, in each case, they had a 30 percent chance of answering the sensitive question, and a 70 percent chance of answering the innocuous question. Aggregation of these samples will be discussed in the next section.

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[12] In general, p_2 need not equal $1-p_1$.

To minimize the variance of the estimated mean of the sensitive question, Greenberg et al. recommend that the ratio of the two sample sizes be close to the ratio of p_1/p_2, which would be 2.33 in this case. Therefore, we randomly assigned 70 percent of our subjects to sample 1 and 30 percent to sample 2. We received responses from 179 subjects in sample 1, and from 85 subjects in sample 2. Our sample size ratios for the NA, IA, and EA groups were 1.91, 2.95, and 1.70, respectively.[13] Variances for the estimated means of the sensitive questions were not the lowest possible, but they were lower than the variances obtained for the corresponding innocuous questions (consistent with the recommended criterion stated previously).[14]

Hypotheses and Test Statistics

We estimated the means of responses to the sensitive questions of the three cases for each group (NA, IA, and EA). For each case, the mean response by the NA group to the sensitive question, μ_{NA}, is determined as follows (see Greenberg et al. 1971, 244):

$$\mu_{NA}=[(p_1)M_1-(p_2)M_2]/(p_1-p_2),$$

where M_i = mean response over all questions (sensitive and innocuous) in sample i $(i=1,2)$.

The means for the IA and EA groups would be computed in a similar fashion. For large sample sizes, these means are asymptotically normally distributed.[15]

We are not able to conduct an F-test for the equality of all three means because the F-test requires that individual responses be known and we do not know whether subjects answered the sensitive or innocuous questions. Therefore, we conduct paired comparison tests for each of the three pairs of means. We first test whether internal auditing is a deterrent to irregularities over and above having no auditing at all. This hypothesis can be stated as follows:

H_{01}: The mean response when no auditing is present is the same as the mean response when internal auditing is present:

$$(\mu_{NA}=\mu_{IA}).$$

Our second hypothesis tests whether external auditing is a deterrent to irregularities over and above having no auditing at all, and is stated as follows:

H_{02}: The mean response when no auditing is present is the same as the mean response when external auditing is present:

$$(\mu_{NA}=\mu_{EA}).$$

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[13] From correspondence with James A. Fox (of Tracy and Fox 1981), we have learned that, while departures from the optimum ratio affect the efficiency of the estimators, they neither bias the results nor introduce systematic error.

[14] We pretested the questionnaires with two faculty members, four graduate students, and four alumni. Our belief that subjects understood the task is evidenced by the fact that of the 259 subjects who responded to the question "Did you find the instructions and cases in this questionnaire to be clear?", 250 (96.5 percent) responded in the affirmative.

[15] The sample sizes for the NA, IA, and EA groups were 96, 87, and 81, respectively.

Our third hypothesis tests whether there is a difference in deterrent effect between internal and external auditing, and is stated as follows:

H_{03}: The mean response when internal auditing is present is the same as the mean response when external auditing is present:

$$(\mu_{IA} = \mu_{EA}).$$

For the first two hypotheses, one-tailed tests are conducted because our alternative hypotheses are that the presence of auditing will cause more recognition of loss/expense than would be the case in the absence of auditing. Since we have no prior beliefs about the impact of internal versus external auditing, the third hypothesis will involve a two-tailed test.

When experimental groups are not of equal size or when error variances differ extremely over treatments, a modified form of the t-test is recommended (Myers 1979, 69).[16] We, therefore, use the following statistic:[17]

$$t' = (\mu_i - \mu_j)/[\mathrm{Var}(\mu_i) + \mathrm{Var}(\mu_j)]^{1/2}.$$

III. Results

Tests of Response Method Difference and Nonresponse Bias

Before aggregating the responses across the two methods of data collection, we tested for possible differences due to method of collection. Tests for the mean response differences across the two methods of data collection showed no significant differences in all cases for all groups, except for Case 3 of the IA group, which was marginally significant ($p \approx 0.10$). We, therefore, conclude that the data obtained by the two collection methods can be treated as coming from one population.

These results also serve to test for nonresponse bias. While our response rate of 50.4 percent for the mailed-in questionnaires ordinarily is considered excellent, it could be argued that the nonrespondents might contain a higher proportion of individuals who would commit financial reporting irregularities. Since the data collected by personal contact yielded a 100 percent response rate, and since virtually all differences between the results of the two collection methods are insignificant, we feel confident to conclude that there is no evidence of a nonresponse bias.

Validity of Innocuous Questions

As discussed earlier, our main concern about the choice of innocuous questions was that their dispersions be larger than those for the corresponding sensitive questions. Greenberg et al. (1971) obtain the following variances for the estimated means of

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[16] We cannot use pooled-variance t-tests for the reason mentioned previously about F-tests.

[17] The degrees of freedom associated with t' is (see Myers 1979, 69 and Greenberg et al. 1971):

$$df = [(n_i - 1)(n_j - 1)]/[(n_j - 1)c^2 + (n_i - 1)(1 - c)^2],$$

where:

$$c = \mathrm{Var}(\mu_i)/[\mathrm{Var}(\mu_i) + \mathrm{Var}(\mu_j)], \text{ and}$$
$$\mathrm{Var}(\mu) = [(p_1)^2 \mathrm{Var}(M_1) + (p_2)^2 \mathrm{Var}(M_2)]/(p_1 - p_2)^2.$$

Table 3

Standard Errors of Estimated Means

	Case 1	*Case 2*	*Case 3*
No-Auditing Group			
Innocuous Question	4813	8202	2307
Sensitive Question	4427	7130	1922
Internal Auditing Group			
Innocuous Question	6384	8985	2871
Sensitive Question	4703	6392	1922
External Auditing Group			
Innocuous Question	5420	8457	2373
Sensitive Question	4842	7174	2076

the sensitive and innocuous questions:

$$\mathrm{Var}(\mu_s)=[(p_1)^2\mathrm{Var}(M_1)+(p_2)^2\mathrm{Var}(M_2)]/(p_1-p_2)^2, \text{ and}$$
$$\mathrm{Var}(\mu_y)=[(p_2)^2\mathrm{Var}(M_1)+(p_1)^2\mathrm{Var}(M_2)]/(p_2-p_1)^2,$$

where:

μ_s = estimated mean for the sensitive distribution, and
μ_y = estimated mean for the innocuous distribution.

The standard deviations (square roots of variances) are reported in table 3, which reveals that for all treatments and cases, the standard errors for the innocuous questions were larger than those for the corresponding sensitive questions. Thus, our main concern about the choice of innocuous questions was satisfied.

Test of Hypothesis H_{01}

Hypothesis H_{01} tests for a deterrence effect caused by internal auditing. Results of the tests are presented in table 4. Case 2 is the only case where introducing internal auditing had a clear-cut effect. This case involves a writedown of inventory to the lower of cost or market value. Those subjects in the internal audit treatment wrote down an average of $24,000 more than did subjects in the no-audit treatment. Using a materiality threshold of five percent, a writedown of less than $35,750 would constitute a material overstatement for Case 2.[18] The quantitative randomized response technique does not permit us to determine an exact distribution of subjects with material overstatements because specific responses are not known to the researcher. We can, however, obtain unbiased estimates of the proportion of overstatements in each group in order to ascertain the relative importance of the writedown amounts to subjects.

We first classified each subject's response into two categories using $35,750 as the cutoff. Using the dichotomous randomized response technique, we next obtained estimated proportions of respondents to the sensitive question whose writedowns would lead to material overstatements of NIBT (i.e., writedowns less than $35,750).[19] For the

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[18] This number is obtained by solving the following for x:

$$[755{,}000-x]/[755{,}000-(0.70)(100{,}000)]=1.05.$$

[19] These estimated proportions, π, are obtained as follows:

$$\pi=(0.7L_1-0.3L_2)/0.4,$$

where L_i = proportion of responses less than $35,750 in sample i.

Table 4
Tests of Hypotheses—All Subjects

	Case 1	*Case 2*	*Case 3*
H_{01}: $\mu_{NA}=\mu_{IA}$			
μ_{NA}	11,285	45,518	14,811
μ_{IA}	17,355	69,503	12,929
t'	−0.94	−2.50*	0.69
df	179	180	181
H_{02}: $\mu_{NA}=\mu_{EA}$			
μ_{NA}	11,285	45,518	14,811
μ_{EA}	17,538	69,995	13,599
t'	−0.95	−2.42*	0.43
df	170	174	170
H_{03}: $\mu_{IA}=\mu_{EA}$			
μ_{IA}	17,355	69,503	12,929
μ_{EA}	17,538	69,995	13,599
t'	−0.03	−0.05	−0.24
df	169	162	164

μ_{NA} = mean response by the No-Audit group to the sensitive question.
μ_{IA} = mean response by the Internal Audit group to the sensitive question.
μ_{EA} = mean response by the External Audit group to the sensitive question.
* $p<0.05$

no-audit treatment, this imputed percentage was 36.1 percent, which is very close to the 34 percent of subjects who materially overstated NIBT in the Uecker et al. (1981) study.[20] For our internal audit treatment, however, only 9.7 percent are estimated to have materially overstated NIBT. This corroborates our finding above that internal auditing had a deterrent effect for Case 2.

Case 1, which involves a potential writedown of a receivable from a key employee, did not provide clear-cut support for internal auditing as having a deterrent effect. While the average losses recognized were in the expected direction and were more than 50 percent greater than was the average for the no-audit group, the magnitude of the difference between them was not statistically significant ($p\approx 0.178$). As with Case 2, we conducted an analysis to estimate the percentage of respondents who would have materially overstated NIBT (the five percent cutoff here is $4,250). We estimated that 74 percent of subjects materially overstated NIBT for the no-audit group, but only 53 percent for the internal audit group. These analyses, therefore, provide a very limited support for a deterrent effect of internal auditing in Case 1.

Case 3 involves an accrual of an invoice for services rendered prior to closing the books. There is a legitimate dispute as to the amount of the bill and, therefore, judgment must be used in determining the amount of the accrual. In this case, the results indicate that internal auditing had no deterrent effect. The average amount of accrual for the internal audit treatment did not differ significantly from that of the no-audit treatment.[21] The differing results of these three cases are consistent with expectations: Case 2, having the strongest deterrence conditions, was highly significant; Case 3, having the weakest deterrent conditions, produced the weakest effect. When all the conditions of Case 2 (i.e., material dollar amounts, irregularities involving asset overstatements, unambiguous GAAP violations, and less incentive for misstating income) were present, internal auditing had a deterrent effect. However, due to the confounding caused by simultaneously varying four factors, we cannot attribute the deterrent effect to any of the individual factors.

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[20] Uecker et al. (1981) used a materiality threshold of 5.2 percent to obtain this percentage.

[21] We could not conduct a supplementary analysis here on percentages of subjects that materially overstated NIBT because, as discussed in section II, the maximum potential overstatement in Case 3 was only 2.3 percent.

Test of Hypothesis H_{02}

Hypothesis H_{02} tests for the deterrent effect of external auditing. The results for all three cases are virtually identical to those pertaining to hypothesis H_{01}. Therefore, the comments in the preceding subsection apply here as well.

Test of Hypothesis H_{03}

Hypothesis H_{03} tests whether there is a difference between internal and external auditing. As stated previously in our hypothesis formulation, we had no *a priori* expectation as to the impact of internal auditing versus external auditing. Results of all three cases indicate that internal auditing has a similar effect on deterring the commission of irregularities as external auditing.

IV. Concluding Remarks

Our study examined the effect of internal and external auditing on financial reporting irregularities. One of our three cases was patterned after the scenario in Uecker et al. (1981) that focused on auditor aggressiveness. This study focused on whether the presence of auditing had an effect on behavior. Moreover, subjects were given treatments involving only one of either internal or external auditing. Finally, the design of this study used the randomized response technique rather than direct elicitation of responses.

We found that the existence of internal auditing and external auditing each had a clear deterrent effect when all of the following four conditions were present: material dollar amounts, irregularities involving asset overstatements, unambiguous GAAP violations, and less incentive for misstating income. This result is inconsistent with the no-deterrent effect reported by Uecker et al. (1981). However, we cannot attribute this effect to any one of the conditions. Also, we found that the effects of internal auditing were similar to those of external auditing.

It is possible that the lack of significance obtained for some of the statistical tests is due, in part, to limitations of this research. First, we provided subjects with a hypothetical incentive of a $20,000 bonus. Though this was a realistic incentive, the subjects would not be receiving any monetary payment to make it a real incentive. Second, despite our efforts to assure anonymity by means of using the randomized response technique, some subjects still may have been reluctant to report truthfully. Regardless of how elaborate safeguards are made to protect subjects' anonymity, self-reports about sensitive matters are not always valid (see, e.g., Hessing et al. 1988, who examined the validity of self-reports regarding tax evasion).

One obvious limitation of this study is the inability to explain why the existence of audits was perceived as having a deterrent effect. No analysis was made of how subjects have cognitively processed the information. This matter remains a question for future research. Finally, we wish to be careful about the generalizability of our results beyond the situation examined here.

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Multivariate Distributional Properties, Outliers, and Transformation of Financial Ratios

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SYNOPSIS: Accounting research that uses financial ratio data often assumes that sets of ratios have multivariate normal distributions. Multivariate distributional properties, multivariate outliers, and modified power transformations were examined to determine whether multivariate normality could be approximated for cross-sectional samples of financial ratios. The results were that the joint distribution of the financial ratios differed appreciably from multivariate normality and the financial ratio data contained multivariate outliers. Approximate multivariate normality was obtained by deleting multivariate outliers and applying modified power transformations to the ratios. Consequently, it would be possible to use multivariate outlier detection and transformation methods in accounting research to enhance statistical conclusion validity and to improve the effectiveness of decision models when multivariate methods that assume normality are used with financial ratios.

Key Words: *Financial Ratios, Multivariate Distributions, Outliers, Transformations.*

Data Availability: *The data used in this study are available in the COMPUSTAT files.*

STUDIES in accounting that use financial ratio data often assume that the ratios are multivariate normally distributed (e.g., Altman et al. 1977; Copeland and Ingram 1982). For example, accounting decision models that use linear discriminant functions minimize expected losses due to misclassifications under the assumptions of

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multivariate normality and equal covariance matrices (Anderson 1984). Furthermore, tests of the equality of covariance matrices that are used during the development of accounting decision models typically assume that variables have multivariate normal distributions (Eisenbeis and Avery 1972). Unfortunately, tests of the equality of covariance matrices are sensitive to multivariate nonnormality (Mardia 1974), and invalid tests of covariance matrices result in suboptimal models. Ohlson (1980) noted that the violation of distributional assumptions in accounting decision models may be unimportant or irrelevant if the only purpose of the models is to develop discriminating devices, but that distributional assumptions are important if significance tests and estimation of valid or good approximations of posterior probabilities are of interest.

Previous accounting research on the cross-sectional distributions of financial ratios has generally been univariate (Deakin 1976; Frecka and Hopwood 1983), even though decision models and methods of statistical inference used with financial ratios often assume multivariate normality (e.g., Altman et al. 1981). Examining the multivariate distributional properties of financial ratios is important, in addition to examining univariate distributional properties, because it is possible that each of several variables taken individually may be univariate normal and yet their multivariate distribution is nonnormal. Multivariate normality implies univariate or marginal normality, but univariate or marginal normality does not imply multivariate normality (Melnick and Tenenbein 1982).

Lack of fit of financial ratio data to multivariate normality is magnified when some observations are multivariate outliers. In contrast to outliers in univariate analyses, outliers in multivariate analyses may consist of data values that do not simply poke out at the ends of univariate distributions. Rather, multivariate data may also be discordant because of subtle, unexpected patterns of values on subsets of variables. Multivariate outliers distort not only means and variances, but also covariances or correlations (Gnanadesikan and Kettenring 1972). Furthermore, multivariate outliers have disproportionate influences on parameter estimates and on the predictions of accounting decision models (Belsley et al. 1980).

Only a few accounting studies have attempted to address the issue of multivariate nonnormal data. In a study of auditors' going-concern opinions, Multcher (1985, 676) wrote: "In order to ensure that the assumptions of the discriminant technique were met, I employed an outlier identification and truncation process." Regrettably, univariate outlier identification and deletion procedures ensure neither multivariate normality nor equal covariance matrices. In analyses of municipal bond rating changes and accounting information, stock returns, and trading activity (Copeland and Ingram 1982; Ziebart 1987), Winsorizing (where extreme values for some ratios were replaced by substitute values) and trimming procedures were used with financial ratio data. Although Winsorizing or trimming procedures are often recommended to restrict the influence of extreme values for estimating location (Barnett and Lewis 1984, 63), caution is advisable for using either of these procedures to estimate correlation or covariance matrices because the usual statistical properties of these estimators are not necessarily retained (Gnanadesikan 1977). Moreover, neither univariate Winsorizing nor univariate trimming procedures are intended to induce reasonable approximations of multivariate normality. The examination of multivariate outliers and multivariate distributional properties have been neglected in many analyses of the cross-sectional distributions of financial ratios, and they deserve further study.

The purposes of this study are (1) to provide evidence on the cross-sectional multivariate distributional properties of financial ratios for manufacturing companies, (2) to present multivariate outlier detection and transformation methods that can be used to approximate multivariate normality, and (3) to provide an analysis of financial ratio data to illustrate these methods.

The remainder of the article is organized in three sections. Section I explains the statistical methods used to examine the financial ratio data. Section II describes the empirical results, and section III discusses implications of the results for accounting research.

I. Statistical Methods

The methods used to examine the multivariate distributional properties of financial ratio data were (1) tests of multivariate normality (Koziol 1982), (2) tests of univariate normality (Lilliefors 1967), (3) transformations (Box and Cox 1964), and (4) methods to identify and delete multivariate outliers (Barnett and Lewis 1984).

Testing Multivariate Normality

Sets of financial ratios can be tested for multivariate normality by using a nonparametric test that was proposed by Koziol (1982). The test uses a Cramér-von Mises type of goodness-of-fit statistic, J_n.

If $\mathbf{x}$ is a $p\times 1$ vector of variables that is multivariate normal, then:

$$d^2=(\mathbf{x}-\boldsymbol{\mu})'\,\Sigma^{-1}(\mathbf{x}-\boldsymbol{\mu}) \tag{1}$$

is distributed as χ^2_p, where $\boldsymbol{\mu}$ is the vector of means for the p variables and Σ is the covariance matrix (Anderson 1984). When a sample is being examined, $\boldsymbol{\mu}$ and Σ are estimated by the sample mean vector $\bar{\mathbf{x}}$ and the sample covariance matrix $\mathbf{S}$. For the ith random observation, $i=1,2,\ldots,n$, estimates of d_i^2s are computed, then the ordered values of the cumulative distribution function of a variable distributed as χ^2_p and evaluated at the estimated d_i^2 scores, $Z_1,Z_2,\ldots,Z_n$, are determined.

The statistic:

$$J_n=\sum_{i=1}^{n}[Z_i-(i-.5)/n]^2+(12n)^{-1} \tag{2}$$

is used to test whether d^2 is χ^2_p distributed. A value of J_n that is larger than the critical J_n percentage points (Koziol 1982, table 1) indicates that d^2 is not χ^2_p distributed. The conclusion, in this case, would be that the variables, financial ratios for this study, are not multivariate normal. Otherwise, the conclusion would be that the estimated d_i^2s reasonably approximate the χ^2_p distribution, and that any difference between multivariate normality and the true joint distribution for the variables is not detectable.

The test statistic J_n is invariant under linear transformations of the form $\mathbf{x}_t=A\mathbf{x}+\boldsymbol{b}$, where $\mathbf{x}_t$ is a $p\times 1$ vector of transformed observations, A is a nonsingular $p\times p$ matrix of constants, and $\boldsymbol{b}$ is a $p\times 1$ vector of constants.

Multivariate normal plots can be used to depict goodness-of-fit of a sample of data to multivariate normality (Healy 1968). The lack of any conspicuous divergence of the sample cumulative distribution function from the normal cumulative distribution function indicates a reasonable fit of the sample data to the multivariate normal distribution.

Testing Univariate Normality

Distributions for individual financial ratios can be examined for univariate normality by using Lilliefors' (1967) nonparametric goodness-of-fit test. Lilliefors' test is based on the maximum difference between the sample cumulative distribution function and the normal cumulative distribution function when the mean and standard deviation are estimated from the sample data.

Testing individual ratios for univariate normality provides information about marginal distributions. But the use of several individual univariate tests ignores correlations among the financial ratios, and multiple univariate tests do not use a joint significance level. Under these conditions, probability statements from univariate hypothesis tests on individual ratios may not be realistic.

Transformations

Logarithmic or square root transformations may induce approximate normality for some financial ratios that are skewed (Deakin 1976; Frecka and Hopwood 1983). However, other transformations may result in even better approximations of normality. For transforming nonnormal variables to normality, Box and Cox (1964) suggested changing a variable y to $y(\lambda)$ by the family of modified power transformations:

$$\begin{aligned} y(\lambda) &= (y^{\lambda}-1)/\lambda, && \text{for } \lambda \neq 0,\ y>0, \\ &= \ell n(y), && \text{for } \lambda = 0,\ y>0. \end{aligned} \tag{3}$$

An estimate for λ is determined such that the logarithm of a normal likelihood function is maximized (Box and Cox 1964). The result is a value for λ that is appropriate to induce approximate normality.

Modified power transformations with values of λ farther from one are characterized as stronger transformations. A λ value of zero for the transformation gives the natural logarithmic transformation and λ values of one-half and one-third are essentially equivalent to square-root and cube-root transformations.

The data should be examined for normality subsequent to the transformation because normality is not guaranteed by applying modified power transformations. However, such transformations usually result in nearly symmetrical distributions even if normality is not attained (Draper and Cox 1969).

Multivariate Outliers

According to Barnett and Lewis (1984), a multivariate observation can be considered to be discordant if it is statistically unreasonable in terms of a statistical model. Additionally, a multivariate observation can be considered to be an outlier if the analyst determines that it is inconsistent with the remainder of the data. Outliers can substantially distort the results of methods of multivariate statistical inference; consequently, outliers are often deleted from data analyses (Afifi and Azen 1979).[1]

Decision models such as bankruptcy prediction models (Altman et al. 1977), auditor opinion models (Mutchler 1985), and bond rating models (Copeland and Ingram 1982; Kaplan and Urwitz 1979) often assume multivariate normality for financial ratio data;

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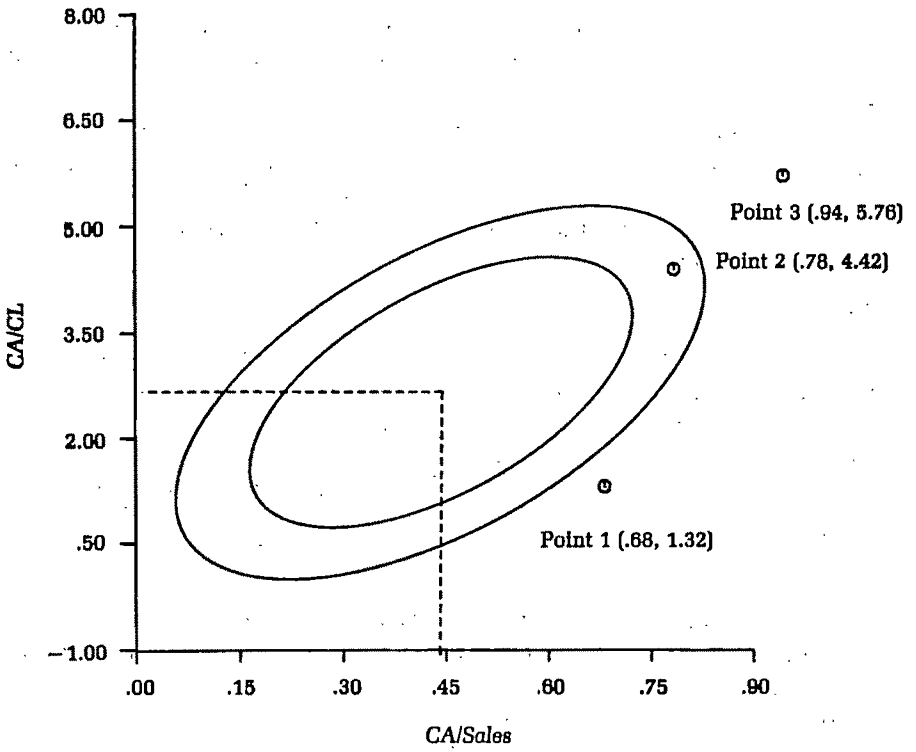
[1] Options to deleting outliers include accommodating them in decision models or welcoming their identification (Barnett and Lewis 1984, 361). For example, robust methods or procedures based on ranks may be used to attempt to accommodate outliers or nonnormality, or nonparametric classification methods may be used. The identification of outliers was welcomed in a problem or failed bank decision model (Sinkey 1977).

Figure 1
Outliers for a Bivariate Normal Distribution*



* Values of (1) *CA/Sales* and (2) *CA/CL* for three companies are represented by points 1, 2, and 3. The dashed lines locate the centroid. Statistical distances from the centroid to the points for the three companies are $d_1^2=6.80$, $d_2^2=3.74$, and $d_3^2=8.95$. The means, standard deviations, and correlation for the bivariate normal distribution are $\mu_1=0.44$, $\mu_2=2.66$, $\sigma_1=0.18$, $\sigma_2=1.24$, and $\rho=0.57$. The larger ellipse is a 90% isodensity ellipse and the smaller ellipse is a 70% isodensity ellipse.

therefore, I employed the following method to detect and delete multivariate outliers to see whether multivariate normality could be approximated for financial ratio data.

The d_i^2 of equation (1) measures the distance of the ith $p \times 1$ multivariate observation vector $\mathbf{x}_i$ from the centroid or mean vector μ. To detect and delete points that lie an extreme distance from the general scatter of points and to induce the data for the ratios to approximate multivariate normality, I selected a χ_p^2 percentage point that would be exceeded by five percent of the observations in a multivariate normal distribution. If more than five percent of the observations in the sample had estimated d_i^2 scores higher than the percentage point of χ_p^2, then the observations with the highest estimated d_i^2 scores were deleted (cf. Barnett and Lewis 1984, 275).

To demonstrate the use of the d_i^2 distance measure of equation (1) for identifying multivariate outliers and to illustrate the distinction between univariate and multivariate outliers, consider *CA/Sales* and *CA/CL* ratios as measures of inventory intensiveness and short-term liquidity (Pinches et al. 1973). Deakin (1972) found both of these ratios, among others, useful in studies of business failures. The *CA/Sales* and *CA/CL* ratios for three companies are depicted in figure 1. The ellipses in figure 1 are isodensity ellipses or concentration ellipses for a bivariate normal distribution. For example, the largest ellipse in figure 1 would be expected to encompass about 90 percent of the observations in random samples taken from the population (Watson et al. 1988).

Point 1 shown on figure 1 represents a company with *CA/Sales*$=0.68$ and *CA/CL* $=1.32$. Point 2 shown in figure 1 represents a company which has *CA/Sales*$=0.78$ and *CA/CL*$=4.42$. For the *CA/Sales* ratio, the first company is 1.33 standard deviations from the mean $[Z=(0.68-0.44)/0.18=1.33]$, and the second company is 1.89 standard deviations from the mean. For the *CA/CL* ratio, the first company is -1.08 standard deviations from the mean and the second company is 1.42 standard deviations from the mean. Using each ratio alone, company 2 may be considered to be more of an outlier than company 1 because company 2 is located further from the mean of the univariate or marginal distribution on each of the ratios taken separately.

However, when distances, d_i^2s (eq. [1]) that account for the positive correlation between *CA/Sales* and *CA/CL* are computed, the first company is found to be statistically further from the centroid of the distribution ($d_1^2=6.80$) than is the second company ($d_2^2=3.74$). Notice that company 1 falls outside of the largest isodensity ellipse of figure 1 and that company 2 is located within this ellipse. Thus, using the d_i^2 distance measures, company 1 would be considered more of an outlier than company 2 with respect to both financial ratios jointly; the outcome of the multivariate method is contrary to the results using univariate methods. The first company could be deleted to attempt to obtain a better approximation of multivariate normality.

A third firm is represented by point 3 on figure 1. Company 3 has the largest statistical distance to the centroid ($d_3^2=8.96$), and each of its ratio values is in the upper tail of the corresponding marginal distribution. Company 3 may be identified as an outlier relative to the other two companies by using either univariate or multivariate methods. This example demonstrates that univariate methods may, but do not always, lead to the same conclusions as multivariate methods.

II. Empirical Results

The results of applying the statistical methods to financial ratio data are presented in three parts: (1) the financial ratios are defined, (2) the populations and samples are described, and (3) the results of applying the statistical methods to financial ratio data are presented.

Financial Ratios

Four of the 11 ratios that were analyzed on a univariate basis by Deakin (1976) and Frecka and Hopwood (1983) were selected for examination using the previously described multivariate methods. The four ratios are (1) current assets/sales (*CA/Sales*), (2) quick assets/sales (*QA/Sales*), (3) current assets/current liabilities (*CA/CL*), and (4) net income/total assets (*NI/TA*).

The ratios were selected because (1) they had been found useful in studies of business failures, (2) univariate methods had shown the ratios to be nonnormal or to be influenced by univariate outliers, and (3) univariate normality had been rejected for the ratios even after applying square root transformations and removing companies considered to be univariate outliers (Deakin 1972, 1976; Frecka and Hopwood 1983).

Table 1
Descriptive Measures Summary for Cross-Sectional Samples of Financial Ratios[a]

Ratio and Sample	*Mean*	*Standard Deviation*	*Skewness*[b]	*Kurtosis*[c]	*Correlation*		
					CA/Sales	*QA/Sales*	*CA/CL*
CA/Sales:							
Smaller	0.49	0.31	3.53	16.47			
Larger	0.49	0.25	3.09	16.82			
QA/Sales:							
Smaller	0.32	0.26	3.72	17.52	0.96 (3)[d]		
Larger	0.30	0.20	3.93	29.42	0.90 (3)		
CA/CL:							
Smaller	2.66	1.55	1.17	15.51	0.37 (2)	0.38 (2)	
Larger	2.58	1.24	3.86	29.41	0.54 (3)	0.55 (3)	
NI/TA:							
Smaller	0.04	0.09	−3.00	14.89	−0.12 (1)	−0.12 (1)	0.13 (0)
Larger	0.04	0.09	−2.22	8.75	−0.01 (1)	0.02 (0)	0.19 (3)

[a] The smaller sample sizes were 98, 99, and 104, and the larger were 399, 403, and 401 for 1982, 1983, and 1984. Values in the table are medians of the descriptive measures for the three samples.

[b] The expected value of skewness g_1 under normality is zero.

[c] The expected value of kurtosis g_2 under normality is approximately zero.

[d] Values in parentheses are the numbers of significant correlations for the three samples ($P<0.01$).

Populations and Samples

The three populations for this study were the manufacturing companies (SIC codes 1900 through 3999) included in the COMPUSTAT files of annual data for 1982, 1983, and 1984. Companies that did not have complete data available for the four ratios defined in the following subsection were omitted (by year) from the study prior to sampling. For each of the three years, one random sample of approximately 100 companies (the small sample) and a second random sample of approximately 400 companies (the large sample) were selected from the population.[2] The two sample sizes were used for each year because it is common for goodness-of-fit tests with large samples to result in statistically significant departures from normality even though the fit may be adequate for practical purposes (Johnson and Wichern 1988, 155).

Results

The sample means, standard deviations, skewness and kurtosis coefficients, and correlations for the samples of financial ratio data are summarized in table 1. The descriptive measures show that the distributions for *CA/Sales*, *QA/Sales*, and *CA/CL* tend to be skewed to the right, that *NI/TA* tends to be skewed to the left, and that all four ratios tend to have positive kurtosis. The significant correlations summarized in table 1 indicate that analyses of the distributional properties of accounting ratios should account for the multivariate structure of the data.

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[2] Random samples were selected by using different seed numbers to generate unequal subsets of companies for the six samples.

Table 2
Multivariate and Univariate Distributional Properties of the Ratios

	Smaller Samples			*Larger Samples*		
Description	*1982*	*1983*	*1984*	*1982*	*1983*	*1984*
Sample size	98	99	104	399	403	401
J_n for testing multivariate normality	2.39**	5.32**	15.80**	16.52**	15.80**	27.90**
L for testing univariate normality of:						
CA/Sales	0.11**	0.20**	0.48**	0.12**	0.12**	0.20**
QA/Sales	0.14**	0.23**	0.49**	0.19**	0.14**	0.27**
CA/CL	0.15**	0.10*	0.22**	0.14**	0.11**	0.17**
NI/TA	0.14**	0.31**	0.15**	0.16**	0.14**	0.20**

* $P<0.05$
** $P<0.01$

The multivariate Cramér/von Mises type statistic J_n was used (Koziol 1982) to test multivariate normality of the four financial ratios for both the smaller and larger samples for each of the three years. The sample sizes and J_n statistics are presented in table 2 and all six of the statistics are significant ($P<0.01$). The conclusion is that each of the joint distributions of the four ratios for the three years differs sufficiently from multivariate normality to reject that distribution. A multivariate normal plot for the test with the 1982 sample of 399 companies is presented in panel A of figure 2. The marked departure of the observed cumulative distribution from the normal cumulative distribution shows the lack of fit of the set of ratios to multivariate normality.

Next, separate tests of univariate normality were done for the four ratios by using Lilliefors' (1967) statistics, L. All 12 of the L statistics computed for the *CA/Sales*, *QA/Sales*, *CA/CL*, and *NI/TA* ratios, the smaller and larger samples and the three years are significant ($P<0.05$), as shown in table 2. Thus, univariate normality is also rejected for each of the four ratios for all three years.

Since multivariate normality was rejected for the four ratios, λ values were estimated for the Box-Cox transformations and the transformations (see eq. [3]) were applied to the ratio data in an attempt to achieve approximate multivariate normality.[3] The estimates of λ for the *CA/Sales*, *QA/Sales*, *CA/CL*, and *NI/TA* ratios for the six samples are presented in table 3. The λ estimates for *NI/TA* were consistently positive and large; whereas, the λ estimates for *CA/Sales*, *QA/Sales*, and *CA/CL* ranged from -0.71 to 0.36. The changes in the λ estimates across years and across the smaller and larger samples may be due to changes in the cross-sectional distributions over time, to outliers, or to instability of the estimator.

After applying the modified power transformations, the transformed data were

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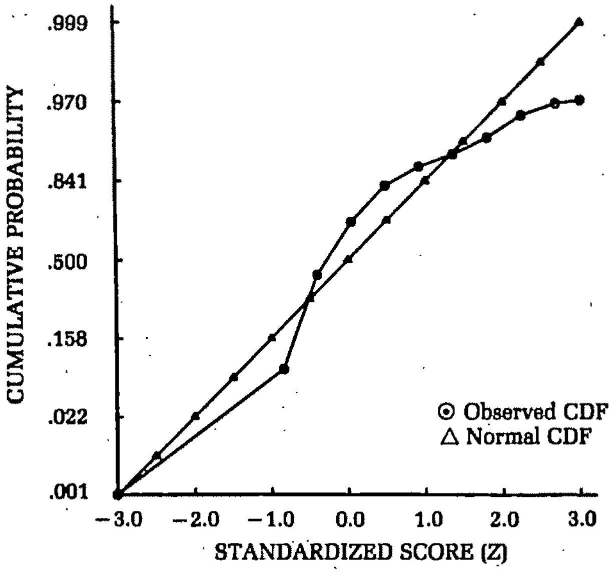
[3] The modified power transformation of equation (3) requires positive sample ratio values. A constant was added to make the sample values of each ratio positive, whenever it was appropriate to do so.

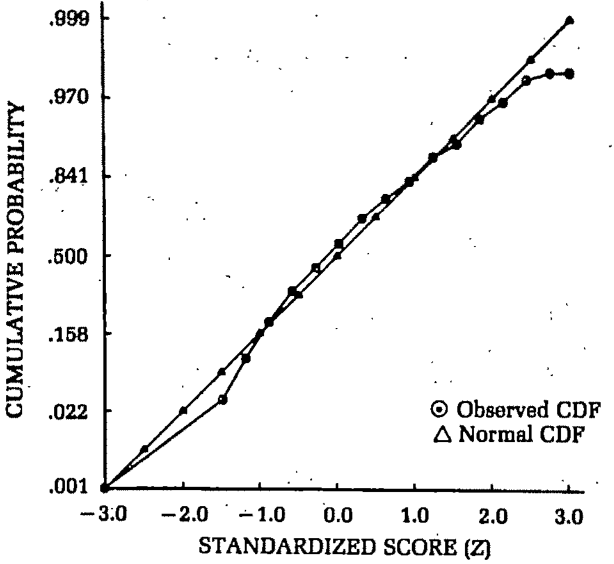
Figure 2

Multivariate Normal Probability Plots for the Larger Sample for 1982*

Panel A. Multivariate Normality (n = 399):



Panel B. Multivariate Normality After Deleting Outliers and Applying Modified Power Transformations (n = 385):



* CDF = cumulative distribution function.

Table 3

Estimates of λ for Modified Power Transformations of the Ratios

Description	Smaller Samples 1982	Smaller Samples 1983	Smaller Samples 1984	Larger Samples 1982	Larger Samples 1983	Larger Samples 1984
Original Data						
Sample size	98	99	104	399	403	401
Estimate of λ for:						
CA/Sales	0.36	−0.71	−0.67	−0.06	−0.11	−0.24
QA/Sales	0.01	−0.51	−0.54	−0.17	−0.20	−0.22
CA/CL	−0.16	0.12	−0.39	0.01	−0.12	−0.39
NI/TA	2.10	5.15	2.84	2.84	2.58	3.62
Multivariate Outliers Deleted						
Reduced sample size	95	96	97	385	385	383
Estimate of λ for:						
CA/Sales	0.30	−0.43	1.20	0.47	0.11	1.11
QA/Sales	0.29	−0.26	1.19	0.17	−0.03	0.90
CA/CL	−0.16	0.17	1.02	0.06	−0.03	0.97
NI/TA	2.51	1.31	1.11	2.85	2.32	1.31

then examined to determine whether reasonable approximations to multivariate normality had been obtained. The J_n statistics are given in table 4. Multivariate normality was still rejected for all six tests after applying the modified power transformations ($P<0.01$).

Following these results, multivariate outliers were identified and deleted (see section I). The probability of a χ^2_4 distributed variable having a value greater than 9.49 is 0.05. Therefore, with a sample of, say, 98 firms, and with the intent to induce approximate multivariate normality for the four ratios, there should be about (0.05)(98), or 4.9, or roughly five companies with statistical distances, d_i^2s, from the centroid that are greater than 9.49. Statistical distances, d_i^2s, were estimated for the sample of 98 companies for 1982 and eight had values greater than 9.49. Thus, the three companies (three percent) that had the highest estimated d_i^2s were identified as multivariate outliers and were deleted from the sample, leaving a reduced sample of 95 companies. The three companies that were eliminated had financial ratios that deviated from the sample mean pattern of ratios to such an extent that they were found to be anomalous. Similar procedures were followed for all six samples. The results in terms of the numbers and proportions of multivariate outliers for all six samples are presented in table 4.[4]

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[4] A second method for identifying multivariate outliers was also employed. A principal components analysis was done for each sample of data. A principal component score was computed for each company for each component that had an eigenvalue greater than or equal to unity. Plots of the scores were then examined and statistical distances to the centroid of the scores were computed for each company to detect multivariate outliers that inflate variances and covariances. Statistical distances for the scores of the residual components with eigenvalues less than unity were computed to detect multivariate outliers that add unimportant dimensions or obscure singularities in the data (cf. Gnanadesikan and Kettenring 1972, 97–111). For the data used in this

Table 4
Multivariate and Univariate Distributional Properties of the Ratios with Multivariate Outliers Deleted and Modified Power Transformations

	Smaller Samples			Larger Samples		
Description	*1982*	*1983*	*1984*	*1982*	*1983*	*1984*
Sample size	98	99	104	399	403	401
J_n for testing multivariate normality after modified power transformations	0.33*	0.44*	0.59*	3.01*	1.84*	4.84*
Number of multivariate outliers	3	3	7	14	18	18
Proportion multivariate outliers	0.03	0.03	0.07	0.04	0.04	0.04
Reduced sample size with multivariate outliers deleted	95	96	97	385	385	383
J_n for testing multivariate normality with multivariate outliers deleted and modified power transformations	0.16	0.13	0.04	0.95*	0.97*	1.29*
L for testing univariate normality with multivariate outliers deleted and modified power transformations of:						
CA/Sales	0.06	0.05	0.07	0.03	0.03	0.04
QA/Sales	0.06	0.05	0.06	0.04	0.04	0.03
CA/CL	0.05	0.05	0.08	0.02	0.02	0.04
NI/TA	0.06	0.09	0.05	0.07*	0.06*	0.06*

* $P<0.01$

After deleting the multivariate outliers, modified power transformations were then reapplied to the data. The estimates for the λs that were computed for the *CA/Sales*, *QA/Sales*, *CA/CL*, and *NI/TA* ratios for the six samples, after eliminating outliers, are presented in table 3.

The results of the tests for multivariate normality, after deleting outliers and applying modified power transformations using the recomputed λ values, are given in table 4. Multivariate normality was not rejected for all three of the smaller samples, but was rejected for all three larger samples, which is not surprising since a large sample size invariably results in a statistically significant lack of fit even though the fit may be adequate for practical purposes (Johnson and Wichern 1988, 155). Multivariate normal

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study, there were few differences in results between the methods using the original data and the methods using the principal component scores. Therefore, the multivariate outlier results were based on the statistical distances for the data without using the principal component scores.

plots were then used to examine the extent of the divergence from multivariate normality for the larger samples. For example, after deleting outliers and applying modified power transformations, the multivariate normal plot for the 1982 sample with outliers deleted is presented in panel B of figure 2. The multivariate normal plot presented in panel B of figure 2, and the plots for the other samples not shown here, suggest that the data, after deleting multivariate outliers and applying modified power transformations, reasonably approximated multivariate normality. Comparing panel A and panel B of figure 2 shows the improvement in the approximation of multivariate normality. The approximation may be adequate for practical purposes even though the differences for the larger samples are statistically significant.

The results presented in table 4 of the Lilliefors tests of univariate normality for the smaller samples, after deleting multivariate outliers and applying modified power transformations using recomputed λ estimates, failed to reject univariate normality for all 12 tests for the four ratios. For the larger samples, the statistics for nine of the 12 tests for univariate normality failed to reject univariate normality. The exception in each year was the *NI/TA* ratio.

III. Discussion

In this study I examine the multivariate distributional properties of a set of financial ratios. My results indicate that financial ratios are likely to include multivariate outliers and to differ substantially from multivariate normality. Nevertheless, the following procedure was used successfully in attempts to induce approximate multivariate normality:

1. Multivariate outliers were identified and deleted using a generalized distance measure that accounted for the multivariate structure of the data.
2. Modified power transformations were applied to the data after the multivariate outliers were deleted.

An average of four percent of the companies in the financial ratio samples were identified as multivariate outliers. However, there is no single omnibus procedure for identifying multivariate outliers that is applicable for all purposes. Other methods may also be appropriate for identifying influential or outlying observations in various models, and it is also possible that some outliers may go undetected due to the masking effects of other extreme observations (Barnett and Lewis 1984; Belsley et al. 1980).[5]

The implications of the results for accounting research are that multivariate statistical inferences, parameter estimates, and predictions of decision models that employ financial ratios and assume multivariate normality are distorted by multivariate outliers and nonnormality. Albeit, the results also imply that the assumption of multivariate normality may be approximated for financial ratios, when accounting decision models assume multivariate normality, by deleting multivariate outliers and applying modified power transformations.

Efron (1975) found that classification models that use discriminant analysis under the condition of multivariate normality are more efficient that those employing logistic regression. Furthermore, Watson et al. (1983) concluded that accounting decision models that produce biased or suboptimal results owing to the violation of distributional assumptions can be improved by using methodological refinements to attain approximate multivariate normality. Consequently, it would be possible to use multivariate outlier detection and deletion methods and transformations in accounting research to improve the effectiveness of decision models that employ financial ratios under the assumption of multivariate normality.

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[5] Dempster and Gasko-Green (1981) suggested a technique for selecting observations in order of discrepancy from a linear model, but stipulated that their technique is intended only for least squares regression under the assumption of normality.

Ball and Foster (1982) indicated that issues of statistical conclusion validity (Cook and Campbell 1979) are particularly important in accounting research where a preponderance of weight is placed on sample evidence. Statistical conclusion validity can be enhanced in accounting studies that employ sets of financial ratios and assume multivariate normality by applying the multivariate methods illustrated here to circumvent complications owing to multivariate outliers and nonnormality.

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Differential Market Reaction to Pooling and Purchase Methods

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SYNOPSIS: In this study I reexamine the impact of merger accounting method by using a sample of tax-free mergers drawn from a different time period and using more refined cumulative average residual (CAR) methodology. As in the Hong et al. study, the purchase method sample exhibits significant positive CARs over the entire period, which appear to originate in the interval preceding the announcement. The pooling method sample does not generate any significant residuals or CARs.

To identify variables for which merger accounting method may be proxying, covariance analysis is used to determine that variables omitted from the capital asset pricing model (CAPM) do not influence the abnormal returns. Furthermore, probit analysis is used to investigate potential *indirect* cash-flow effects such as managerial income manipulation. A positive relationship between leverage and income-reducing policies is observed. This suggests that firms with high financial risk (leverage) may prefer purchase accounting to reduce reported earnings and regulators' attention. Tax characteristics of the acquired firms (net operating loss and investment tax credit carryforwards) are also examined as they can result in indirect cash-flow effects, such as reduced *post*merger corporate income taxes. The limited data available indicate that tax factors have little impact on the CARs.

Finally, a variable representing the relative bargaining strengths of the merging firms is tested for association with accounting method used. A statistically significant relationship is observed, and two implications follow from this result: (1) acquiring firms in a strong bargaining position are more likely to use the purchase method, and (2) as the bargaining strength of the

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acquiring firm *decreases*, the consideration given to the target firm *increases* while the magnitude of the CARs *decreases*.

The contributions of the study are as follows. First, the abnormal returns to tax-free purchase method mergers, first observed by Hong et al., are found to persist and appear to originate during the preannouncement period. Second, other CAPM-omitted variables do not appear to influence these results. Finally, two tests of the association between potential *indirect* cash-flow effects and the CARs are significant and provide a partial explanation for the observed abnormal returns.

Key Words: *Pooling Method, Purchase Method, Mergers, CAR Methodology.*

Data Availability: *Data utilized in this study are available from the author.*

EMPIRICAL evidence suggests that acquiring firms' equity values do not increase in a significant manner during the period surrounding the merger (Mandelker 1974; Ellert 1976; Langetieg 1978) or in the period surrounding the merger announcement date (Dodd 1980, Asquith and Kim 1982; Malatesta 1983). Yet, Hong et al. (1978) observed significant positive abnormal returns in the period surrounding the merger date for a sample of mergers that used the "purchase" method of accounting, but not for mergers that adopted the "pooling" method. Although financial statements typically differ under the two methods, these differences lacked direct cash-flow impact in the mergers studied by Hong et al., so that merger accounting method probably was not the cause of the observed market differences. The objective of this study is to examine the extent to which merger accounting method was a proxy for other variables in the Hong et al. study.

I. Background

Merger Returns to Acquiring Firms

Early merger studies (e.g., Mandelker 1974; Ellert 1976; Langetieg 1978; Elgers and Clark 1980) use monthly data to estimate CARs around the "merger effective date," the date of final approval by the target firm's stockholders. The observed positive CARs, however, occur about a year or more prior to the effective date. The likely explanation is that, in an efficient market, much of the market response to a merger occurs around the earlier public announcement of the proposed merger.

Later studies use the announcement date and estimate weekly or daily residuals to more accurately determine when the market reaction occurs. For example, Dodd (1980) observes positive CARs of 5.4 percent in the 41 days prior to and including the announcement date. Eckbo (1983) notes significant CARs of 4.9 percent for a sample of horizontal mergers that were contested by antitrust law enforcement agencies in the period 20 days prior to, and the ten days following, the first public announcement. Finally, Asquith (1983) shows a significant CAR of 14.5 percent for the period 480 days prior to and including the announcement date.

In summary, any market response to a proposed merger likely will be observable around the first public announcement date, due to information leakage and evaluation of the potential economic impact.

Merger Accounting Methods

If a merger satisfies 12 specified conditions in Accounting Principles Board Opinion No. 16 (APBO 16) (1970), *pooling-of-interests* accounting must be used and the net assets of the acquired firm remain stated at *book* value. Failing any of the 12 conditions requires use of the *purchase* method under which assets acquired and liabilities assumed are restated to their *fair market* values, and goodwill is recorded and amortized if the consideration given exceeds fair value of the net assets.

Ceteris paribus, postcombination net income under the purchase method will be lower (higher) than under pooling when the value of the consideration paid exceeds (is less than) the book value of the net assets acquired. If, however, the merger qualifies as a tax-free reorganization under Sections 354 and 368 of the Internal Revenue Code, the tax bases of assets acquired and liabilities assumed remain unchanged. Consequently, the two accounting methods can result in different *reported* earnings that have no *direct* impact on tax-related cash flows. Merger accounting method, therefore, would not likely be the cause of any observed valuation differences between samples of tax-free mergers but instead would proxy for one or more underlying variables.

The Hong et al. Study

Hong et al. examined monthly price movements of a sample of 122 pooling method and 37 purchase method mergers occurring from 1954–1964 (prior to APBO 16). All qualified as tax-free reorganizations so that differential tax-related cash-flow effects were avoided. As Hong et al.'s sample included only mergers in which the market value of the securities issued exceeded the book value of the net assets acquired, firms using the purchase method reported higher depreciation and amortization charges and, therefore, lower net income than if pooling-of-interests accounting had been used.

No statistically significant abnormal price behavior was observed for the pooling method sample in the 120-month period surrounding the effective date of the merger. In contrast, the purchase method sample exhibited strong positive price movement in the 12 months preceding the effective date, with the CAR reaching 8.8 percent ($p \leq 0.05$). Several factors, however, make it difficult to draw inferences from Hong et al.'s results: the residuals were centered around the effective date instead of the announcement date; monthly residuals were used; average residual and CAR values were not reported; and finally, their sample of purchase method mergers was small and occurred primarily in the first four years of their 11-year test period.

Hypotheses

In light of these results, this study seeks to investigate potential explanations for the differential market reaction observed by Hong et al. Using a different sample and time period, a three-step approach is utilized. First, CARs for a sample of tax-free mergers are examined without regard to merger accounting method used, focusing primarily on the period leading up to the announcement date. In null form, the first hypothesis tested is:

H1: Residuals for the acquiring firms will not be significantly different from zero.

Second, the sample is disaggregated into pooling and purchase method mergers, leading to hypothesis H2 and a replication of Hong et al.:

H2: No differential market reaction will be observed between the subsamples of pooling and purchase method firms.

Third, if hypothesis H2 is rejected, as suggested by Hong et al.'s results, the underlying variable(s) for which the accounting method may be serving as a proxy will be examined.

II. Sample Selection and Methodology

Sample Selection

Potential sample firms during 1971 to 1982, a post-APBO 16 time period, were identified in *Mergers and Acquisitions*. Merger accounting method and tax status were obtained from the merger proxy statements. Sample selection techniques were similar but generally more restrictive than those used by Hong et al. A size screen of five percent (the ratio of shares issued in the acquisition to acquiring firm shares outstanding prior to the merger) was used to exclude mergers expected to have no measurable impact. Also, companies with one or more other mergers whose combined value exceeded 25 percent of the merger under study during the estimation and test periods were excluded from the sample.[1] Final samples of usable firms were 108 pooling method and 69 purchase method mergers. The average size of an acquired firm relative to the market value of the acquiring firm was 16.3 percent for the pooling sample (21.9 percent in Hong et al.), and 18.5 percent for the purchase sample (not reported in Hong et al.).

Methodology

The returns for a particular firm i in time t are represented by the market model:

$$r_{it}=\alpha_i+\beta_i r_{mt}+\epsilon_{it}, \tag{1}$$

where r_{mt} is the market return in period t; α_i and β_i are the conventional market model coefficients for firm i using the CRSP value-weighted index; and ϵ_{it} is a stochastic residual term that is assumed to satisfy OLS assumptions.

An important assumption underlying this model is that systematic risk (β_i) does not change significantly over the period under study (Sunder 1973). Because mergers may alter the underlying risk of the combining firms (e.g., Dodd and Ruback 1977; Galai and Masulis 1976; Mandelker 1974), this study, similar to Hong et al., estimated one set of parameters for the preannouncement period and another set for the postannouncement

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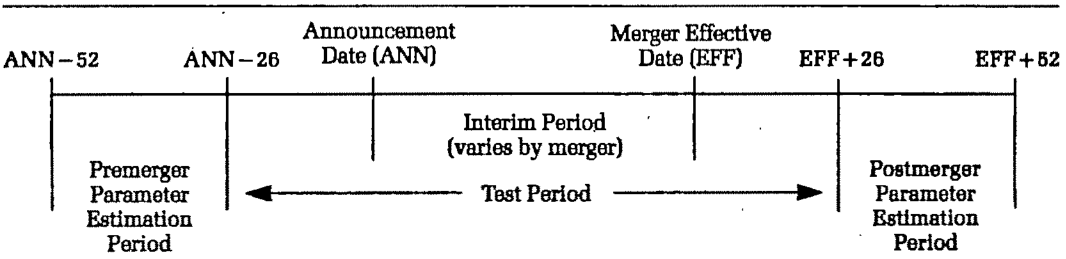
[1] Hong et al. also used a 25 percent valuation exclusion, but only for 24 months of their 60-month observation period. This resulted in two methodological weaknesses. First, CARs were estimated during periods when other significant mergers also may have been occurring. Second, their market model parameter estimation period overlapped the CAR observation period, so that their parameter estimates also could have been influenced by other significant mergers.

Table 1
Estimation and Test Periods, in Weeks


ANN−52
ANN−26
Announcement Date (ANN)
Merger Effective Date (EFF)
EFF+26
EFF+52
Interim Period (varies by merger)
Premerger Parameter Estimation Period
Test Period
Postmerger Parameter Estimation Period

period.[2] Moreover, the expectation of nonzero residuals around the event dates necessitates obtaining the parameter estimates during a period excluding those event dates.

Table 1 summarizes the time periods used here. Weekly residuals[3] are estimated for a test period extending from 26 weeks before the merger announcement date (ANN−26) to 26 weeks after the merger effective date (EFF+26). Market model parameters are estimated during the 26 weeks prior to and after the test period. Because the interval between the announcement and effective dates varied across mergers (the mean was 102 trading days as in Dodd 1980), the test period varied from one merger to another.

Average residuals (AR) and cumulative average residuals (CAR) for each sample are given by:

$$AR_t=(1/M)\sum_{i=1}^{M} e_{it}, \tag{2}$$

$$CAR_T=\sum_{t=a}^{T} AR_t, \tag{3}$$

where M = the number of firms in the group; a = the first week of the cumulation period; and T = the last week of the cumulation period.

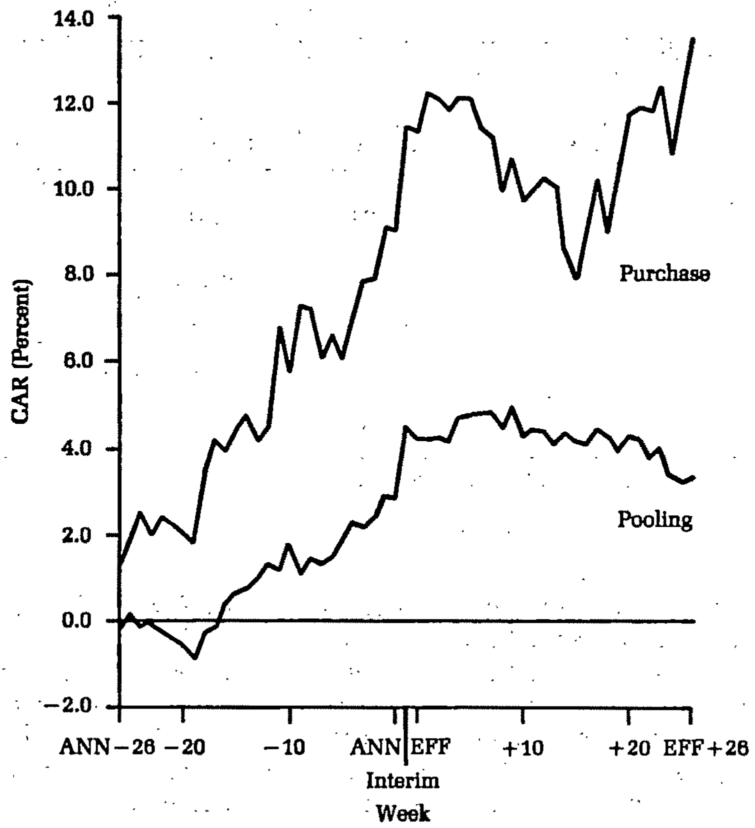
The test statistic is the mean standardized CAR, described at length in Dodd and Warner (1983). To compute this test statistic, the residual e_{it} is standardized by its estimated standard deviation s_{it}[4] to form:

$$Se_{it}=e_{it}/s_{it}, \tag{4}$$

[2] Postannouncement period mean beta increased (decreased) slightly for pooling (purchase) method firms. Neither change was significant, but given variability in individual firm betas and the importance of beta in estimating residuals, the two sets of parameters were used.

[3] Marais (1984) finds that weekly residuals may deviate from normality with respect to skewness and kurtosis. The CARs in this study were examined and some did deviate from normality due to a few outliers. When these were removed, normality was approximated, with little change in the overall results.

Figure 1
CARs Over Test Period for Pooling Method and Purchase Method Samples



pooling/purchase results documented here may be due to the accounting method proxying for one or more of these variables. Analysis of covariance (ANCOVA) is used to assess whether these variables exercise any detectable influence on the CARs. The variables are defined as follows:

P/E ratio:	Price to earnings ratio at the end of the year prior to the announcement year.
Size:	The natural log of the market value of the firm's outstanding stock at the beginning of the announcement year is used.
α, β:	The preannouncement period estimates of *alpha* and *beta* are used.
Earnings surprise:	Change in annual EPS in the announcement year divided by share price at the beginning of the announcement year.[8]
Leverage:	Ratio of the book value of total liabilities to total assets at the end of the year prior to the announcement year.

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[8] This formulation assumes that market earnings expectations follow a random walk without drift. While some studies include a drift term (e.g., Bernard 1986), both Ricks (1982) and Biddle and Lindahl (1982) find their results to be relatively insensitive to the choice between a random walk with and without drift. Also, share

Table 3
Analysis of Covariance—Dependent Variable: CAR; Treatment Variable: Merger Accounting Method; Covariates: Alpha, Beta, Acquirer Size, Earnings Surprise, and Leverage

Week −11 through Announcement Week (N=168)[1]

Source	*Degrees of Freedom*	*Sum of Squares*	*Mean Square*	*F-statistic*	*p-value*
Equality of adjusted cell means	1	0.0354	0.0354	1.57	0.21
Zero slope for covariates	6	0.1248	0.0208	0.92	0.48
Error	160	3.6051	0.0225		
Equality of slopes	6	0.1929	0.0321	1.45	0.20
Error	154	3.4122	0.0222		

[1] Nine firms excluded due to outlier values for P/E ratio.

The 11-week period prior to the announcement week, during which most of the significant CARs originate, is used in the ANCOVA analysis. These results are reported in table 3. Merger accounting method is not significant, nor are any of the potentially confounding covariates. The test for equality of slopes does not support rejection of the hypothesis that the regression coefficient for each covariate differs among groups. Thus, the ANCOVA results indicate that the differential pooling/purchase method returns noted first by Hong et al., and replicated here, are not explained by these nonmerger related omitted variables.

Postmerger Indirect Cash-Flow Impacts

This section describes three procedures employed to ascertain whether the differential returns—and the apparent importance of merger accounting method—are linked to potential indirect cash-flow effects.

Managerial Income Manipulation. Several researchers have investigated the proposition that managers manage their firms' reported earnings. For example, Watts and Zimmerman (1978) argue that the incidence of political costs (regulation, negative publicity, etc.) is related to firm size and that larger firms tend to lobby for accounting standards that reduce income. Also, Zmijewski and Hagerman (1981) find a significant positive relationship between income-increasing policies and the existence of management

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price is used as the deflator to avoid the small or negative denominator problem that can occur with EPS. Christie (1987) also concludes that the "correct" deflator in returns studies is the market value at the beginning of the period. The analysis was performed using quarterly earnings, defining the surprise as actual earnings minus the *Value Line* forecast, using the most recent earnings before the merger announcement. Data were available for 86 pooling method and 36 purchase method firms. Results were similar to those presented in table 3.

Table 4

Probit Analysis*

Dependent Variable: 0 for Purchase (Income Deflating), 1 for Pooling (Income Inflating)

Expected Sign	(−)	(−)	(−)	(−)	(?)		
Constant	*Beta*	*Capital Intensity*	*Total Assets*	*Concentration Ratio*	*Leverage*	χ^2 Test	*% Correctly Predicted*
0.9683 (0.967)	0.0430 (0.190)	0.1841 (0.990)	−0.0001 (−1.449)	−0.3165 (−0.298)	−2.2005 (−2.851)[a]	12.12[b]	70.1

[*] Asymptotic *t*-statistics in parentheses.
[a] Significant at 0.01.
[b] Significant at 0.05.

compensation plans based on reported earnings.[9] Because the pooling and purchase methods generally have a differential effect on reported earnings, management might value these differential effects highly and attempt to structure the merger so that one or the other accounting method could be used.[10]

Probit analysis, a dichotomous dependent variable model, is used to estimate this impact, where zero is for income-decreasing effect and one is for income-increasing effect.[11] The variables used in this study are the same as in Hagerman and Zmijewski (1979) and Zmijewski and Hagerman (1981), which are *size* (total assets and total sales; results are presented only for total assets as each measure yielded similar outcomes), *beta*, *capital intensity* (fixed assets/total assets), *competition* (market share), and *leverage* (total debt to total equity).

Coefficients estimated for the probit model appear in table 4; negative coefficients indicate association with an income-reducing policy. *Leverage* is the only significant variable.[12] Univariate tests indicate the same finding: leverage for the purchase method sample (0.23) is significantly higher than for the pooling method sample (0.18, $p \leq 0.05$).

Although this outcome is not consistent with studies that find a negative relationship between leverage and income-reducing policies, Crawford (1986) provides a possible explanation. He notes that purchase method firms are more likely than pooling method firms to have debt covenants based on net assets or net tangible assets rather than on income. No analysis of this issue is performed in this study.

Tax Effects. Even though tax-free mergers generally have no direct tax effects on the merged companies, net operating loss (NOL) or investment tax credit (ITC) carryforwards possessed by the acquired firm could reduce postmerger corporate income

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[9] Other studies include Daley and Vigeland (1983), Holthausen and Leftwich (1983), and Crawford (1986).

[10] Satisfying all 12 conditions specified in APBO 16 is required for the pooling method to be used; companies cannot simply "choose" which accounting method will be used. Meeting these conditions may not be a costless procedure for either bidder or target.

[11] Hagerman and Zmijewski (1979) and Zmijewski and Hagerman (1981) provide a complete discussion of the inappropriateness of OLS and a review and application of probit analysis to these types of situations.

[12] Multicollinearity may reduce the significance of collinear variables. The largest correlation (0.385) is between *leverage* and *capital intensity*.

Table 5
Characteristics of the Excess of Market Value of Consideration Paid (MV) Relative to the Book Value of the Acquired Firm (BV)

	Poolings	*Purchases*
MV−BV (mean value, in millions)	\$60.7[1]	\$22.1[1]
(MV−BV)/BV (mean value)	206.3%[1]	81.2%[1]
(MV−BV)/NI[2] (mean value)	201.9%[1]	76.9%[1]

[1] Means significantly different at .01.

[2] NI = Net Income of acquiring firm in the year prior to the merger announcement date. The allocation of the excess to specific assets is generally unknown, so that amortization periods are also unknown. Comparing the excess to one year's income obviously overstates the annual impact, but does allow for relative comparison between the two samples.

taxes.[13] To examine the extent to which such *indirect* cash-flow effects affect CARs differently for the two types of mergers, I examined data for 27 pooling method target firms and 25 purchase method target firms[14] from the COMPUSTAT Research File. Five of the purchase targets and none of the pooling targets had NOL carryforwards. This distribution provides weak support for the hypothesis that the CAR results for the purchase method acquiring firms may be due, in part, to the market impounding this potential benefit into share price. In three of these five mergers, however, the acquiring firm *also* had an NOL prior to the announcement and after the effective dates, possibly deferring the benefit of the acquired NOL. Only one target in each category had an ITC carryforward. Thus, the limited data available indicate that the indirect cash-flow effects of taxes may not be a material factor in determining CAR differences.

Bargaining Strength. The marketplace for mergers is imperfectly competitive because every firm is somewhat unique, so that there are no perfect substitutes. The final transaction price can also be influenced by the bargaining strengths and skills of merger participants. In addition, the excess of the transaction price, or market value of consideration given, over the book value of the acquired firm's net assets, represents a wealth transfer to the acquired firm's shareholders and may be indicative of each firm's relative bargaining strength. The larger this excess, the lower (higher) the bargaining strength of the acquiring (target) firm, so that the acquiring firm may be predisposed toward using the pooling method in order to avoid recording the premium and its subsequent amortization.

Table 5 reports the "excess" for the sample companies from three different perspectives: absolute amount; percent of book value of the acquired firm; and percent of the acquiring firm's net income in the year preceding the announcement date. From all three perspectives, the mean excess is found to be significantly higher for the pooling method mergers, which is consistent with the phenomenon described above.[15]

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[13] Scholes and Wolfson (1989) note that tax laws can provide compelling motivations to structure a merger as tax-free if the acquired firm has NOLs.

[14] Data were not obtainable for the remaining target firms.

[15] Using bid premia, Robinson and Shane (1990) note a similar result with their sample of 95 mergers.

Table 6
Regression of Bargaining Strength Proxy (BSP) Against Firm CAR Values[1]

Week −11 through Announcement Week		$\bar{R}^2$
Both Samples Combined: (N=169)[2]	CAR=0.06074−0.02247 BSP (−2.547)[a]	0.037
Pooling Method Firms Only: (N=104)[2]	CAR=0.02864−0.00836 BSP (−.899)	0.008
Purchase Method Firms Only: (N=65)[2]	CAR=0.09617−0.05823 BSP (−2.481)[a]	0.089

[1] t-statistics are in parentheses.

[2] Small book values (BV) relative to large market values (MV) can result in disproportionately large values for BSP. Four pooling method and four purchase method firms were excluded, as their BSP values ranged from 9.6 to 109.6 (mean value 39.7) whereas the majority of the BSP values ranged from 0.002 to 5.0 (mean value 1.5).

[a] Significant at 0.05.

To test for an association with the CARs, the proxy for bargaining strength (BSP) is assumed to be approximated by the second measure in table 5:

$$BSP=(MV-BV)/BV. \tag{7}$$

It is hypothesized that as BSP *increases*—implying that the acquiring firm's bargaining position *decreases*—the CARs would *decrease*.

To test this hypothesized relationship, BSP is regressed against the acquiring firms' CARs during the same 11-week preannouncement period used in the ANCOVA analysis. The results, reported in table 6, are as hypothesized. BSP's coefficient is negative and significant for the combined samples and for the purchase method mergers separately. The BSP coefficient for the pooling method mergers is also negative but is not significant. Thus, it appears that there is a reasonably predictable association between the CARs and the proxy for relative bargaining strength.[16]

Two conclusions follow from this analysis. First, the larger the excess of market value paid over the underlying book value of the net assets acquired, the more likely the merger will be structured as a pooling-of-interests. Second, the magnitude of the excess appears to proxy for the relative bargaining strength of the two parties. The larger the wealth transfer, the lower the abnormal returns to the acquiring firm's shareholders. Indeed, for the pooling method acquiring firms analyzed here, which paid an average excess nearly three times that paid by the purchase method firms, their shareholders, on average, did not reap any significant abnormal returns.

V. Summary and Conclusions

This study replicates and extends the study by Hong et al. (1978). First, using a different time period and sample, abnormal returns for a sample of tax-free mergers are estimated and significant CARs are observed in the preannouncement period. However, the results differed by merger accounting method. The purchase method subsample exhibits significant positive CARs over the entire period, whereas the pooling method subsample's CARs are not significant.

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[16] Similar results were obtained using the 26-week preannouncement period (−26 through ANN) and the entire test period (ANN−26 through EFF+26).

A positive relationship between leverage and income-reducing policies is observed, suggesting that highly leveraged firms may prefer purchase method accounting to reduce reported profits. Also, the association of the CARs with a proxy for relative bargaining strength is significant. This outcome suggests that the magnitude of the CARs is negatively correlated with the amount paid in excess of book values and that pooling-of-interests accounting is more likely to be used when the excess is large.

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Factors Associated with the Disclosure of Managers' Forecasts

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SYNOPSIS: This study examines the motivation of managers to release forecasts of future earnings. Four potential motivating factors were compared for a sample of firms that reported forecasts and another sample of firms that did not release this information. The four factors are: (1) reporting good news, (2) correcting or confirming analysts' forecasts, (3) new capital offerings, and (4) ownership structure.

A manager's forecast released when analysts have underestimated earnings implies good news. The relative importance of the correction or confirmation of analysts' forecasts was tested by examining the absolute errors of analysts' forecasts. Larger absolute errors of analysts' forecasts for reporting firms than for other firms imply that managers' forecasts could be correcting forecasts. Otherwise, they are confirming forecasts.

The literature also suggests that some managers release forecasts prior to issuing new capital. This hypothesis was tested by examining the occurrences of new capital offerings for the reporting and comparison firms.

Differences in ownership structure represent a fourth factor potentially associated with the release of forecasts. Prior literature suggests that the release of forecasts when outside holdings are relatively high can help reduce agency costs. The association of ownership structure with the release of forecasts was tested by examining the percentage of inside ownership for the reporting and comparison firms.

Multivariate tests show that ownership structure, absolute errors of

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analysts' forecasts, and new capital offerings are significant. Absolute errors of analysts' forecasts are smaller for the forecast reporting firms than for the comparison firms, suggesting that managers' forecasts are, on average, confirmatory. The results also reveal that new capital is more likely to be issued subsequent to the date of the forecast (or equivalent date) by the reporting firms than by the comparison firms. However, the evidence is not consistent with the assumption that managers release good-news forecasts.

Additional joint tests were conducted using data for the years before and after the forecast release. These tests show that absolute analysts' forecast errors and capital offerings are not significant factors for the years before or after the forecast release, suggesting that these factors reflect the motivation of managers to release earnings forecasts.

Key Words: *Earnings, Forecast, Inside Ownership, Capital Offering.*

Data Availability: *Related projects are presently in process. The data will be made available for general research purposes upon completion of these projects and can be obtained from the authors at that time.*

THE public reporting of earnings forecasts by managers is presently voluntary and only a minority of businesses provide public forecasts.[1] Because these earnings forecasts are followed by investors, regulatory agencies have shown interest in finding out why some firms report forecasts publicly while others do not. The Securities and Exchange Commission (SEC), for example, is concerned with forecast disclosure and in 1979 instituted a safe harbor rule governing the legal liability associated with inaccurate forecasts (SEC 1979).

A number of theories and survey findings may explain the managers' decision to disclose forecasts. These include the release of forecasts to communicate good news (Ross 1979; Verrecchia 1983), to correct or confirm analysts' forecasts (Lees 1981), to facilitate new capital offerings (Lees 1981), and to signal the manager's planning ability (Trueman 1986). Empirical tests to date, however, have been limited to the relationship between forecast reporting and good news. Only one study (Ajinkya and Gift 1984) has investigated the role of managers' forecasts in correcting or confirming analysts' forecasts. The other theories have not been tested.

In this paper we examine some possible determinants of the motivation of managers to release forecasts of future earnings. The study introduces ownership structure and capital offerings, two possible determinants not previously tested, and reports on joint tests of the ability of these and other variables to explain the reporting decision. Tests for a sample of firms that reported forecasts and for a sample of comparison firms that did not report forecasts show that ownership structure and the issuance of new capital are more closely associated with the decision to report forecasts than are the other variables examined in the study. The results also suggest that managers' forecasts tend to confirm rather than correct forecasts by financial analysts.

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[1] Patell's (1976) search in *The Wall Street Journal* revealed fewer than 100 qualifying large firm disclosures per year.

The next section presents background and develops the research hypotheses. Following this are descriptions of the samples of firms and the independent variables. The paper then presents the study results and conclusions.

I. Hypotheses

Good News

Ross (1979) suggests that if favorable disclosures increase the value of the firm, then outsiders will interpret no news as bad news. As a result, all managers without bad news have an incentive for disclosure, and only firms with the worst news will fail to disclose the information. Verrecchia (1983) follows this reasoning with a model showing conditions under which information will be disclosed given that nondisclosure can be interpreted either as (1) bad news, or (2) good news with high anticipated disclosure costs.

The disclosure of good news may also satisfy personal objectives such as job retention. For example, Trachtenberg (1989) writes that Avon Products Inc. forecasted good news following a hostile takeover bid and that at least one analyst interpreted the good news forecast as a takeover defense (consistent with job retention). Empirical evidence of the role of good news in motivating forecast disclosure is mixed. Pastena and Ronen (1979) conclude that most forecasts in their sample contain good news, while more recent studies (Ajinkya and Gift 1984; Waymire 1984) did not observe an overall tendency to report good news.[2] To determine the possible motivating influence of good news, we tested the following hypothesis:

H_1: Firms that release forecasts tend to have good news relative to other firms.

Correction or Confirmation of Analysts' Forecasts

Lees (1981) notes that forecasts by managers can improve relations with financial analysts. In his view, disclosure facilitates the jobs of analysts by either correcting or confirming analysts' forecasts. Managers' forecasts that correct analysts' forecasts can minimize the danger of unrealistic analysts' forecasts, while confirming forecasts increase confidence in them. These views were tested by Ajinkya and Gift (1984). The present study examined analysts' forecasts to test the following hypothesis:

H_2: The absolute errors of analysts' forecasts differ for forecast reporting and nonreporting firms.

If managers' forecasts correct analysts' forecasts, managers are more likely to release forecasts when analysts' errors are material. In this event, larger absolute errors of analysts' forecasts will be observed for reporting firms than for other firms. Smaller absolute errors of analysts' forecasts for reporting firms imply that managers' forecasts tend to confirm analysts' forecasts.

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[2] Studies including Ajinkya and Gift (1984) and Waymire (1984) show that the market classifies large numbers of forecasts as bad news. Managers, however, may still believe that forecasts will be interpreted favorably (or less unfavorably than if no news is disclosed). One reason is that firms release forecasts only occasionally, and as a result managers cannot develop extensive histories relating forecast releases for their firms to stock prices.

New Capital Offerings

Numerous studies document the decline in stock price associated with the issuance of new securities (e.g., Myers and Majluf 1984). Leland and Pyle (1977) attribute this price reduction to outsiders' reluctance to increase investments given that managers know more than outsiders and given the associated problems of adverse selection and moral hazard. Miller and Rock (1985) and Hughes (1986) note that direct disclosure can have value in the presence of disclosure laws and restrictions on insider trading. In a disclosure law environment, public releases of earnings forecasts have potential for alleviating the adverse selection and moral hazard difficulties. Additionally, managers responding to the survey by Lees (1981) indicated that forecasts enhance the ability to attract new capital and that this may be the most important benefit of forecast release. This leads to the third hypothesis:

H_3: Forecast reporting firms show a greater tendency than other firms to issue new capital.

Ownership Structure

Jensen and Meckling (1976) assert that as the manager's ownership share of the firm's equity falls, outside shareholders have increased incentives to expend resources to monitor the manager's behavior. Reasons include increased incentives for the owner-manager to consume perks and reduced incentives for the owner-manager to maximize job performance. Leftwich et al. (1981) apply this reasoning to voluntary interim reporting. In that study, the authors included a size variable (with insignificant results) to reflect the agency costs of outside ownership because they did not have data on the amount of outside capital. The present study tests the effect of inside ownership more directly with the following hypothesis:

H_4: Forecast reporting firms have a higher proportion of outside ownership than other firms.

Planning Ability

Trueman (1986) asserts that the good news theory is not sufficient to explain forecast reporting since earnings information will be reported anyway. In Trueman's view, the release of a forecast indicates that the manager has identified environmental changes and plans to adjust operations accordingly. This view implies that the manager should be equally motivated to release good news and bad news as long as the expected benefits exceed the costs of disclosure.

Direct tests of Trueman's theory would require identification of relevant changes in business circumstances and estimates of disclosure costs. The literature has not identified operational measures of these variables and, therefore, we cannot test the hypothesis here.

II. The Sample

The sample was selected from forecasts included in the Dow Jones News Retrieval Service from January 1980 through December 1985. This service contains articles from *The Wall Street Journal* and *Barron's* and announcements on the Broad Tape. The entire text of articles in the data service was searched for keywords including "forecast" and

Table 1

Summary of the Sample Selection Process for Firms Voluntarily Reporting Forecasts of Earnings (January 1980 through December 1985)

Total point or range forecasts on Dow Jones News Retrieval Service	322
Less: Repeat forecasts during the same year	10
Firms not listed or without complete data on COMPUSTAT	129
Firms without complete IBES data	26
Firms with forecasts in the same month as the fiscal year end	11
Total usable forecasts	146

"projection." Forecasts included in the sample meet all of the following criteria: (1) a point or range estimate of annual earnings or earnings per share before extraordinary items made by a company official; (2) release in the first 11 fiscal months; (3) no prior forecast release for the fiscal year indicated in the Dow Jones News Retrieval Service or *The Wall Street Journal Index*; (4) 1987 COMPUSTAT data available for the reporting firms; and (5) analysts' forecasts available on the 1987 Institutional Brokers Estimate System (IBES) data base. IBES contains weekly updates of composite analysts' forecast information and adjusts earnings per share forecasts for stock splits and stock dividends. The sample includes 146 qualifying forecasts as shown in table 1. Disclosures are approximately equally distributed over the fiscal year with 70 firms reporting forecasts in the first half, and 76 firms reporting in the second half.

A comparison group of similar-sized firms that did not report forecasts during the observation period was developed from the same four-digit industry code. The size match was necessary because previous studies, including Cox (1985), show that firms with forecasts reported in the press tend to be relatively large. Since we do not expect size to influence the disclosure decision, the matching procedure isolates the editorial policy consideration by compensating for the expected tendency of news services to publish information for larger firms. The matching entailed grouping the comparison firms by industry and selecting a comparison firm with asset size closest to that of the reporting firm.

Firms were eligible for the comparison group if no earnings forecasts of any type appeared in the Dow Jones News Retrieval Service or *The Wall Street Journal Index* for the period January 1980 through December 1985 and sufficient data were available on COMPUSTAT and IBES. When qualifying comparison firms could not be located within the four-digit industry, three-digit and two-digit industry codes were used. Panel A in table 2 shows that all except 16 of the 146 firms were matched on four-digit industry codes. Panel B shows that asset sizes vary substantially with 13 reporting firms having assets less than $100 million and 59 reporting firms having assets in excess of $1 billion.

Table 2

The Distribution of Industry and Asset Size

(n=146 Forecast Reporting Firms and 146 Comparison Firms, 1980–1985)

Panel A. Industry Match:

	Number of Comparison Firms
By four-digit industry code	130
By three-digit industry code	6
By two-digit industry code	10
Total	146

Panel B. Asset Size:

	Number of Firms	
	Reporting Firms	*Comparison Firms*
Less than $100 million	13	19
$100 million to $1 billion	74	72
More than $1 billion	59	55
Total	146	146

III. Independent Variables

Analysts' Forecast Errors as Indications of Good News

Since managers' forecasts are not available for the comparison sample, we used the errors of analysts' forecasts as indications of good news. Assuming that managers have more recent information than do analysts (e.g., Hassell and Jennings 1986), managers' forecasts released when analysts have underestimated income represent good news. This can be shown using the McNichols (1989) decomposition of errors of analysts' forecasts into two components:

$$E_t - AF = (MF - AF) + (E_t - MF), \qquad (1)$$

where MF is the manager's forecast; AF refers to the previously available analysts' forecasts; and E_t is the actual earnings.

Given McNichols' conclusion that managers' forecasts are relatively free of systematic bias, $E_t - AF$ should be an unbiased estimate of $MF - AF$. For managers' forecasts included in this sample, the observed product-moment correlation is +0.82, indicating that $E_t - AF$ should provide a good proxy for $MF - AF$.

The analysts' forecast errors were adjusted for earnings variability because previous research shows that: (1) the absolute errors of analysts' forecasts tend to be lower for forecast reporting firms than for nonreporting firms, and (2) earnings variability is also lower for reporting firms (e.g., Imhoff 1978). If the earnings of reporting firms are relatively stable, the errors of analysts' forecasts for these firms will be low. To control for this effect, the error variable was calculated as in Waymire (1985) as follows:

$$\text{Analysts' forecast error} = (E_t - AF)/s_t, \tag{2}$$

where s_t is the standard deviation of primary earnings per share over the eight-year period prior to the earnings forecast.

For each reporting firm, the measure of the analysts' forecasts was the mean of the IBES analysts' forecasts for the month prior to the manager's forecast. The same fiscal month was then used for the comparison firm. All forecasts and earnings were adjusted for stock splits and stock dividends. In summary, the errors of analysts' forecasts adjusted for earnings variability were adopted as proxies for good news. A positive association between the release of forecasts and the underestimation of earnings by analysts indicates that managers tend to report good news.

Absolute Errors of Analysts' Forecasts

We calculated the absolute errors of analysts' forecasts to examine the confirmation or correction functions of managers' forecasts. The same adjustment for earnings variability was made as for the signed error measure. Large absolute errors of analysts' forecasts indicate material corrections consistent with the correction function. Small errors are consistent with the confirmation role of managers' forecasts.

New Capital Offerings

The question of whether or not firms issuing new capital are more inclined to release earnings forecasts was examined by comparing new capital offerings for the reporting and comparison firms. If new debt or new stock was offered within three months after the forecast reporting date, but before the annual earnings announcement, a value of one was assigned to the capital offering variable. Otherwise, a zero value was assigned. An indicator variable was used because of the large number of zero values. The three-month period is a compromise. Only a few firms issued new securities within one month of the forecast, but longer periods increase the likelihood of forecast obsolescence. Data were obtained from the *Directory of Corporate Financing*.

Ownership Structure

The hypothesis that ownership structure is related to the decision to report forecasts was tested by examining the percentage of voting stock owned by officers and directors. Most of the ownership information was obtained from *The Value Line Investment Survey*, *Standard & Poor's Corporation Records*, proxy statements, and Form 10-Ks.

IV. Univariate Results

Summary statistics for each variable are in table 3. Panel A data do not reveal significant differences between the errors of analysts' forecasts for the reporting and comparison samples (Wilcoxon test) and, thus, do not support the hypothesis that managers release primarily good news. In support of the confirmation role of managers' fore-

Table 3
Summary Statistics and Univariate Tests of the Relation Between Explanatory Variables and the Voluntary Reporting of Managers' Earnings Forecasts ($n=146$ Forecast Reporting Firms and 146 Comparison Firms, 1980–1985)

Panel A. The Continuous Variables:

		Quartile					
	Mean	*.25*	*.50*	*.75*	*Standard Deviation*	*z*	*Probabilty*
Analysts' Forecast Errors ($(E_t-AF)/s_t$):							
Reporting firms	−0.19	−0.66	−0.10	0.20	0.96	−0.26[a]	0.40
Comparison firms	−0.17	−0.61	−0.04	0.30	1.16		
Absolute Errors of Analysts' Forecasts ($\lvert E_t-AF\rvert/s_t$):							
Reporting firms	0.69	0.14	0.40	1.01	0.77	−2.31[b]	0.02
Comparison firms	0.92	0.17	0.49	1.34	1.04		
Percentage of Voting Stock Owned by Officers and Directors:							
Reporting firms	0.10	0.02	0.06	0.12	0.12	−4.61[a]	0.01
Comparison firms	0.18	0.03	0.12	0.26	0.18		

Panel B. Firms Offering New Capital within Three Months after the Forecast Date (or Equivalent Date):

	Number of Cases	*t-statistic*	*Probability*
Reporting firms	19	2.49	0.01[c]
Comparison firms	7		

[a] Wilcoxon matched-pairs signed-ranks test (one-tailed).
[b] Wilcoxon matched-pairs signed-ranks test (two-tailed).
[c] T-test for differences in proportions (one-tailed).

casts, the absolute errors of analysts' forecasts are smaller for the reporting firms than for the comparison firms with differences significant at the two percent level (Wilcoxon test). Panel A also shows that inside ownership is lower for the reporting firms than for the comparison firms with differences significant at the one percent level (Wilcoxon test). Panel B shows that the reporting firms have more capital offerings than the comparison firms. These differences are significant at the one percent level (*t*-test of proportions).

Correlations Between Variables

Pearson product-moment correlations between the continuous independent variables are shown in table 4. All correlation coefficients are small with no cross-correlations exceeding seven percent. Consequently, multicollinearity is not a concern in the multivariate tests.

V. The Multivariate Analysis

The joint ability of the independent variables to explain the reporting decision was examined using probit analysis (see Finney 1971). Previous studies in accounting have

Table 4

Pearson Product-Moment Correlations of Continuous Independent Variables ($n=146$ Forecast Reporting Firms and 146 Comparison Firms, 1980–1985)

	Analysts' Forecast Error	*Absolute Analysts' Error*	*Ownership Structure*
Analysts' forecast error	1.000	0.058 (0.32)ᵃ	−0.068 (0.25)
Absolute analysts' error		1.000	−0.044 (0.45)
Ownership structure			1.000

ᵃ Parentheses indicate two-tailed probability values.

used probit analysis because probit estimators are consistent and unbiased with dichotomous dependent variables as discussed in Hagerman and Zmijewski (1979).[3] Another advantage of probit is that it permits significance tests on individual parameters and on overall classifications. The model is:

$$F=a+b1*ERROR+b2*ABSERROR+b3*CAPOFF+b4*OWN+e, \quad (3)$$

where for each firm: $F=1$ for a reporting firm, and 0 for the comparison firm; $ERROR=(E_t-AF)/s_t$; $ABSERROR=|E_t-AF|/s_t$; $CAPOFF=1$ if the firm offered long-term debt or equity within three months after the manager's forecast and 0 otherwise; OWN = percentage of voting stock owned by managers and directors; and e = a random disturbance term.

To examine the statistical significance of the model, a log likelihood ratio statistic was computed (e.g., McKelvey and Zavoina 1975). This statistic has a chi-square distribution (with four degrees of freedom). Table 5 shows that the model is statistically significant at the one percent level with a chi-square statistic of 28.6.[4] The model correctly classifies 66.1 percent of the cases (73.3 percent of the reporting firms and 58.9 percent of the comparison firms). These results were then compared with the predictive ability of the most successful naive model that categorizes all observations as members of the larger group of firms (e.g., Pinches 1980). The test of proportions reveals that the percentage of cases correctly predicted by the probit model exceeds that achieved by the best naive model at the one percent level.

Asymptotic *t*-statistics were used to test the significance of the estimated coefficients. Ownership structure is the most important variable with a *t*-statistic of −3.874 significant at the one percent level. The capital offering variable follows with signifi-

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[3] The model was also estimated with logit analysis, another commonly used technique for dichotomous dependent variables. The resulting significance levels for each coefficient and for the model are nearly identical to the probit model results reported here.

[4] Probit analysis assumes that the random disturbance terms are independent and identically distributed normal random variables. The Kolmogorov-Smirnov goodness-of-fit test ($z=0.968$, significance$=0.31$), indicates that the probit residuals do not deviate significantly from normality (see Hollander and Wolfe 1973, 219–28).

Table 5
Probit Analysis of Forecast Disclosure Model
(n=146 Forecast Reporting Firms and 146 Comparison Firms, 1980–1985)

Model: $F=a+b1{*}ERROR+b2{*}ABSERROR+b3{*}CAPOFF+b4{*}OWN+e$

Percentage of cases predicted correctly	66.1 overall 73.3 reporting firms 58.9 comparison firms
Chi-square statistic (4 df)	28.6 (0.01 significance)

Independent Variables	*Analysts' Forecast Error*	*Absolute Analysts' Error*	*Capital Offerings*	*Ownership Structure*
Maximum likelihood estimate	−0.14	−0.183	0.560	−0.021
Asymptotic *t*-statistic	−0.213	−2.125	1.911	−3.874
Significance level	0.459[a]	0.034[b]	0.028[a]	0.001[a]

Variable Definitions:

F=1 for a reporting firm and 0 for the comparison firm,

$ERROR$=errors of analysts' forecasts adjusted for earnings variability: $(E_t-AF)/s_t$,

$ABSERROR$=absolute errors of analysts' forecasts adjusted for earnings variability: $|E_t-AF|/s_t$,

$CAPOFF$=1 if the firm offered long-term debt or equity within three months after the manager's forecast and 0 otherwise, and

OWN=percentage of voting shares owned by officers and directors.

[a] One-tailed test.

[b] Two-tailed test.

cance at the 2.8 percent level and the absolute error of analysts' forecast variable is significant at the 3.4 percent level. Signed forecast errors are not significant at conventional levels. The directions of association are the same as for the univariate tests examined earlier.

Two additional probit analyses were conducted to examine the potential motivating influence of the capital offering and absolute analysts' error variables. The first used analysts' forecast errors and capital offerings for the year prior to the forecast release, and the second used data for the subsequent year. Ownership structure was held constant in these tests because short-run changes tend to be minimal.

The *t*-statistics for the independent variables range from −3.869 to 0.276 with significant coefficients for the years before and after forecast release only for ownership structure. These tests confirm that the greater frequency of capital offerings and the smaller absolute errors of analysts' forecasts are associated with the reporting firms only for the reporting years.

VI. Summary and Conclusions

The purpose of this study was to examine the ability of selected variables to explain the motivation of managers to release forecasts of future earnings. Based on a review of the literature, we developed variables and tested the association of forecast reporting with good news, the role of managers' forecasts in correcting or confirming analysts' forecasts, new capital offerings, and the percentage of inside ownership in the firm.

The tests compared a sample of firms reporting forecasts to the public to a sample of firms not releasing forecasts. The comparison firms are similar in size to the reporting firms and are in the same industries.

The multivariate analysis shows that ownership structure is the most important factor distinguishing the reporting and comparison firms. The measure of new capital offerings is the next most important factor and suggests that capital offerings motivate forecast release. A tendency to release forecasts when the absolute errors of analysts' forecasts (adjusted for earnings variability) are relatively small also contributes to the model. This finding indicates that firms are more likely to release forecasts that confirm analysts' forecasts than to release forecasts that make material corrections to them.

The signed analysts' error measure is not significant, indicating that a desire to report good news does not seem to motivate forecast release. This finding is consistent with much of the recent empirical literature (Ajinkya and Gift 1984; Waymire 1984).

The major restrictions on the sample are availability of a forecast, COMPUSTAT listing, and IBES data. The last two criteria, in particular, restrict the sample to larger, publicly traded firms.

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BOOK REVIEWS

Shane R. Moriarity, Editor

Editor's Note: Two copies of books for review should be sent to Professor Shane Moriarity, School of Accounting, University of Oklahoma, Norman, OK 73019.

SARAH BALL, *Directory of International Sources of Business Information* (London: Pitman Publishing, 1989, pp. vi, 698, £65.00).

The worldwide proliferation of organized business-related information over the last ten years or so has created a need for a "database of world databases." This useful but occasionally frustrating directory goes some way towards filling that need. It provides an up-to-date, remarkably comprehensive list of business information sources worldwide, and its European flavor will be a welcome change for many U.S. readers. However, its content, format, and organization limits its usefulness for most academic researchers to preliminary data exploration.

The directory provides three services, although it is not organized on that basis. First, three short chapters and four appendices provide a miscellany of background information, of mixed value to accountants, on European stock market legal requirements, European information brokers, and how on-line databases operate. Some information, such as the multi-page matrix of "Which hosts provide which databases?", is extremely useful; other items, such as the descriptive table of 38 stock markets around the world, are merely interesting; but few accountants need technical data on international packet switching.

Nearly half of the directory comprises two chapters listing data sources by country and by industry. Both are a goldmine of information. The country chapter lists the name, address, and phone/fax number of hundreds of organizations in each of 30 countries which provide business information, including banks, stockbrokers, chambers of commerce, government departments, and professional associations. Titles and publishers of commercial directories, newspapers, and periodicals are also included. Although each of the 11 industries in the following chapter is subdivided by country, sources are rarely duplicated. A thorough search of both chapters is therefore necessary, since the criteria by which sources were assigned to each chapter are not obvious. Generally, the industry chapter is more detailed, providing trade association information, and titles and publishers of periodicals and recent market research reports, including the price of the latter. These two chapters provide a good start for an international data and literature search.

For the computer-based researcher, the third service provided by this directory is a chapter describing some 600 business-related online databases. The description of each database is conventional, including a brief but adequate summary of the content, source, producer, host name(s), and cost for each. The U.S. database information is of course readily available elsewhere; the value of this chapter lies in its extensive coverage of foreign-language, especially European, databases. Unfortunately, the chapter is divided into 13 ambiguous and overlapping sections (e.g., "General Management," "Industry-wide Databases," and "EEC Databases"). The researcher looking for specific data, therefore, may have to scan up to 270 pages of text, made no easier by the use of a single typeface for all text and titles, and the absence of a section title on each page.

My frustration came from several small irritations and idiosyncracies. First, the design is poor. It is typeset, but not right justified, and layout and readability are often compromised, presumably to minimize the page count. Judicious use of boldface for titles would have helped immensely. Typographical errors are frequent. Second, there are some inexplicable omissions. Only New York-based newspapers are listed in the U.S. "major newspapers" section. And perhaps the best-known of all online financial research databases, the CRSP database, is not listed. Also omitted are several other commercially available financial databases (e.g., the IBES database of earnings forecasts) which are often used for research. Non-British readers will notice the British origin of the directory, which results in trivial biases, but also more important flaws. A typical example: only Japanese and British addresses are listed for sources of Japanese trade and commercial information. Finally, there is no index. Although the page header of the third appendix is "alphabetical listing/page numbers," no page numbers are given.

This useful directory fills a six-year void in the literature. Academic researchers with cross-national interests will find it especially useful in the early stages of prospective projects, for investigating online data availability. It would, however, have been more useful, and far easier to use, in machine-readable format, with software for keyword search. Nevertheless, until that time, it should be on the reference shelves of every business library.

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DIRAN BODENHORN, *Economic Accounting*, Foundation of Accounting Series (New York and London: Garland Publishing, Inc., 1988, pp. iii, 326, $40.00).

Professor Bodenhorn argues that the function of accounting is to measure wealth and income. In economic accounting, wealth is measured by recourse to current market prices. Debits are increases in the holdings of economic instruments; credits are decreases in those holdings. Income is treated as a residual, being derived from two successive measurements of wealth plus consumption over the period. "Real" capital is maintained by an adjustment based on changes in a general index of consumer goods prices. Much of the conventional accounting wisdom is rejected. The determination of income by matching costs with revenues is shown to have no place in economic theory. The products of cost allocations are declared to be without "economic foundation" and "incorrigible." Inconsistencies in the application of the conventional realization and accrual principles are replaced by the use of current market prices alone for valuation purposes and the recognition of "value added" (or lost) as determined by the market (or price) system. But, the objects of valuation are not the individual assets and liabilities of a firm. Economic accounting seeks to value the firm as a whole, by valuing shareholders' equity at market, and to provide disaggregated information about groups of assets, called "projects." Accordingly, we must ask the question—whose wealth and income is being measured?

Economic accounting is based on a general equilibrium model, a "Crusoe economy," from which inferences are drawn about the real world. In such an economy, there is only one price for a given class of commodities. Consequently, the question of whether wealth should be measured by use of buying or selling prices does not arise. In the real world, uncertainty, transactions costs, and other manifestations of market imperfection result in there being (potentially wide) differences between the buying and selling prices for a commodity. Whether wealth should be measured in terms of buying or selling prices is a question about which Professor Bodenhorn expects there to be an "endless and fruitless" debate, for it is alleged that there is "no theory to provide an answer" to the asset aggregation problem (p. 286).

Further, in a "Crusoe economy," the way in which assets are grouped for valuation purposes is insignificant—for the aggregate sum of the market prices of individual assets (however grouped) is equal to the total discounted value of future returns to shareholders (the value of the firm). And the present value of a share is equal to its current market price. The implication is that, in a "Crusoe" economy, firms will have zero net wealth—the aggregate market value of the economic instruments will equal the aggregate market value of the equities.

Under real-world conditions, however, Professor Bodenhorn argues that in economic theory there is "no way to value the individual assets of a firm to obtain the value of the firm." Accordingly, he suggests that accountants have embarked on a "theoretically impossible task." But that is a task accountants have never set out to perform. The market values firms as wholes, and for those firms whose shares are not publicly traded that value is arrived at by guesswork. Nevertheless, Professor Bodenhorn suggests that the object of valuing individual assets and liabilities should be abandoned in favor of valuing the firm as a whole and that "useful guesses or estimates" should be made about the "sources of the value" in terms of groups of assets (projects). "We must start with a meaningful whole, and try to break it into parts, rather than to start with the parts and try to add them together to get a meaningful whole" (p. 286). That objective is claimed to be consistent with economic and finance theory. However, for the majority of firms, there is not an active market in their shares. In most cases, therefore, the market price of shareholders' equity cannot be readily discovered. And that poses the greatest problem for economic accounting—the determination of the interest rate to be charged on equity capital (the cost of equity capital). In the majority of cases, therefore, the "meaningful whole" is the product of an anticipatory calculation for which there is no commerical referent.

While not required for income determination purposes, Professor Bodenhorn recommends the provision of disaggregated financial information about projects. That creates another dilemma for economic accounting—the introduction of cost-based valuation when there is no discoverable market price for a project. In a "Crusoe economy," each productive project has an independent production function with which cash flows are distinctly identifiable. Under real-world conditions, however, projects are not independent—assets interact. The extent of interdependency between projects will determine the extent to which arbitrary allocations must be made in accounting for them as single "cost objects." And that is inconsistent with an object of economic accounting—to be allocation free. While economic accounting apparently seeks to bypass the problem of additivity, by valuing the firm as a whole rather than the individual assets and liabilities, that problem is inescapably at issue when presenting disaggregated financial information about projects.

Under "ideal" conditions, economic accounting is based on current market prices. Under real-world conditions, however, Professor Bodenhorn appears to settle for a modified historical cost system in which the matching of costs and revenues is replaced by the discounting process, interest on all equities (including shares) is accrued periodically, and projects replace individual assets as "cost objects."

Economic Accounting is a thought-provoking treatise that confronts fundamental problems in accounting, exposes theoretical flaws in the conventional wisdom, and presents a model of accounting based on modern finance theory. Being based on a general equilibrium ("Crusoe") model, interdependent criteria are developed for national income accounting, business accounting, and household accounting. Professor Bodenhorn's use of simple cases to gain an understanding of more complex systems is similar to the approach adopted by Professor Sterling, whose influence (along with that of Professor Ijiri) on his thinking about accounting is acknowledged.

The work is presented in three parts: part I (chapters 1 and 2) presents the introduction and summary, and an explanation of the "Crusoe model"; part II (chapters 3–8) contains the underpinnings and structure of economic accounting; and part III addresses some accounting problems which arise under real-world conditions. It deserves the attention of all accounting theorists.

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LAWRENCE D. BROWN, JOHN C. GARDNER, and MIKLOS A. VASARHELYI, *Accounting Research Directory: The Database of Accounting Literature*, Second Edition (New York: Markus Wiener Publishing, Inc., 1989, pp. iv, 583, $49.00).

This reference work indexes, classifies, and gives citation scores for articles appearing in six leading accounting journals: *The Accounting Review* (*AR*); *Accounting, Organizations & Society* (*AOS*); *Auditing: A Journal of Practice & Theory* (*AJPT*); *Journal of Accounting & Economics* (*JAE*); *Journal of Accounting, Auditing & Finance* (*JAAF*); and *Journal of Accounting Research* (*JAR*);. Major articles for the 1963–1988 time period are listed. The first edition of this book was previously reviewed here (H. S. Hendrickson, *AR*, October 1986, p. 787).

Like the previous edition, this book consists of two major divisions. Part 1 gives full bibliographic references; articles are listed alphabetically according to authors with full entries for each co-author. Part 2 consists of abbreviated references, classified according to each of four different taxonomical classifications described in the previous review. Within each classification category, articles are listed in descending order of ratings determined from citations per available years in the *AR*, *AOS*, *JAE*, and *JAR*.

The new edition contains three significant additions. First, the years 1985–1988 are included. Second, the four categories and citation indexes for each article are given in Part 1 as well as Part 2. Third, all indexed articles are listed in the Part 2 sections, yet readers who scorn the uncited will not be inconvenienced, since unreferenced articles reside at the bottom of each list.

The book has three likely uses. First, it can serve as a quick guide for those who can remember any of the author's names for a key article, but need more exact information for location or reference. Second, it can enable those interested in quantitative literature analysis to test and verify much of the work in this area by the authors of this book (*AR*, April 1985, pp. 262–277; *JAR*, Spring 1985, pp. 84–109; *AOS*, No. 2, 1987, pp. 193–204; *Contemporary Accounting Research*, Spring 1989, pp. 793–815). Finally, and most likely, the book can help professors identify the seminal works in specific areas of interest. This can be particularly beneficial in designing reading lists for graduate courses.

An inherent difficulty with a work of this type, is that numerous debatable choices (e.g., journals, taxonomy structure, classification within the structure, classification of each article) must be made; any particular reader is likely to dissent from some of them. This reviewer would include *Contemporary Accounting Research* in the list of journals, would include citations for all journals indexed, and would more often classify according to narrow rather than general criteria (e.g., Dittman and Prakash, "Cost Variance Investigation: Markovian Control of Markov Processes," *JAR*, Spring 1976, pp. 14–25, was classed as "Quantitative: Analytical" even though the category "Quantitative: Markov" was available).

Another problem is the lack of sufficient discussion of criteria and reasons for inclusion and classification decisions. The definition of "major article," the criterion for inclusion, needs elaboration. Apparently, *AR* "Notes" qualify, and *JAR* "Capsules" qualify, but comments do not qualify; the decisions are reasonable, but deserve explanation. Such choice criteria should be provided for each selected journal. Still, these problems do not greatly diminish the utility of this work.

In summary, this is a significantly improved edition. This unique book shows which works in various areas have most strongly influenced recent academic accounting research. The book should continue to be especially valuable in preparing reading lists for accounting doctoral programs and seminars.

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COOPERS & LYBRAND, *Retiree Health Benefits: Field Test of the FASB Proposal* (Morristown, NJ: Financial Executives Research Foundation, 1989, pp. 215, $12.00).

Under the sponsorship of the Financial Executives Research Foundation, Coopers & Lybrand conducted a field test of the FASB's Exposure Draft (ED) entitled, *Employers' Accounting for Postretirement Benefits Other Than Pension*. The objectives of the test were to discover some of the potential problems that might be encountered in applying the ED and to examine the impact of the ED on enterprise financial statements. To accomplish the objectives, the accounting treatment specified in the ED was applied to the postretirement health care plans of a nonrandom sample of 26 firms. Each of the participating firm's 1988 revenues exceeded $250 million, with most in excess of $1 billion.

The report outlines the general nature of the companies included in the field test and their plans. Company names and specific details that might permit the identification of a participant are omitted from the report. The measurement process used in the study is described along with the problems that were encountered in implementing the process. Numerous problems were encountered in gathering both the demographic and medical claims data needed to implement the measurement process. For example, "limited or nonexistent information on spouses and children of retirees was common" (p. 58). Also, in some cases it was even difficult to determine from existing plan documents, what benefit coverage was being provided under the terms of the plan. The report contains a description of the creation of a data base that was used by the companies in estimating their respective health care trend rates.

The study's results are presented in Chapters 6 and 8. The intervening chapter provides, "... information on how retiree health accruals under the ED might interact with SFAS No. 96." The chapter is written for those readers who are already familiar with the contents of SFAS No. 96 (Accounting for Income Taxes). According to the discussion, under some circumstances, some or all of a firm's increased postretirement health care expense under the ED would not require a debit to prepaid taxes. Thus, in the extreme case all of the increase would fall directly to the bottom line.

The study's results indicate that, among other things, the Field Test companies' expenses under the ED, in the year of adoption (1988), ranged from under two to more than seven times the amounts recorded by the companies on a pay-as-you-go basis. Further, the multiples for the firms with immature plans (more than six active employees for each retiree) were generally higher than those for highly mature plans (less than two active employees for each retiree).

The impact of the ED on a firm's financial statements depends in part on how much of the increased expense will be subject to a provision for prepaid taxes. Under the assumption that all of the increase will be subject to such a provision, the decrease in 1988 net income from applying the ED would have ranged from less than two percent to greater than 20 percent. The median decrease was somewhere between five percent and 9.9 percent with nine of the firms showing a decrease of ten percent or more.

The 1988 increase in the companies' total liabilities under the ED would have ranged from less than 0.5 percent to greater than two percent with the median effect being between 0.5 percent and one percent. However, if all of the accumulated postretirement benefit obligation (APBO) is treated as a liability, the increase in total liabilities would have ranged from less than three percent to a high somewhere between 15.1 percent and 20 percent. Further, the study's analysis shows that, "an additional liability would be required to be recorded five years after adoption of the ED (year 6) for 73 percent of the Field Test companies" (p. 121).

An interesting part of the study is its analysis of the "sensitivity of obligations and expenses to alternate health care cost and discount rate assumptions" and the "impact of alternative approaches to various provisions contained in the ED ..." (p. 81). For example, a one percent decrease in the health care cost trend rate used by the companies would have caused the APBOs and expenses of a majority of the companies to fall by ten percent to 14.9 percent.

In summary, the Field Test represents the most comprehensive and reliable study done to date on the potential impact of the ED on enterprise financial statements. It should be pointed out (as is done in the report) that in interpreting the study's results, several things need to be kept in mind. First, the sample is small and heavily biased toward the inclusion of relatively large, successful firms with mature plans. Second, the results do not reflect the potential effects of the Medicare Catastrophic Coverage Act although the general nature of the Act and its impact (the Act would mitigate the impact of the ED) is discussed in a separate chapter. This omission is not a serious limitation since the existing Act has been repealed. Finally, the results relate to an adoption in 1988. While the general nature of the results would not change, adoption in a different year could alter the magnitudes of the results.

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SHERMAN L. LEWIS, *The Improvement of Corporate Financial Performance* (New York: Quorum Books, 1989, pp. xvi, 379, $49.95).

The author's objective is to provide management with the keys to "sustainable sales and profit growth within acceptable limits of risk ..." (xiii) and to overcome failures in control that are cited regularly in the literature.

The book is divided into three parts that emphasize different types of information needed for different purposes. Part one includes eight chapters that deal with planning and evaluating alternatives. Part two includes four chapters concerned with performance evaluation and control. The last part includes four chapters that address some additional aspects of accounting systems.

Chapter 1 provides several illustrations of basic financial statements and financial analysis. The author discusses several traditional topics such as return on assets, liquidity, return on equity, and earnings per share. Chapter 2 is devoted to a discussion of current assets, including inventory and receivables. Chapters 3 through 5 cover capital expenditure analysis in some detail. The author's approach is somewhat different from much of the existing literature. For example, he indicates that the cost of capital is not relevant in determining the discount rate. Instead, the discount rate must be a risk-free rate represented by the current after-tax borrowing rate. He also argues that the same discount rate should be used by all segments, thus the discount rate should not be adjusted for risk. Chapter 6 is devoted to traditional product costing topics, including standard costing, a discussion of departmental overhead rates, separate rates for material-related overhead costs, and service department cost allocations. Unfortunately, the discussion of overhead cost drivers is limited to units, direct labor, materials, and machine time. Chapter 7 includes illustrations of break-even analysis and incremental cost decisions such as make or buy. In Chapter 8, the market plan is separated in terms of markets, branches, and products. This chapter also includes a discussion of decentralization and intra-company transfers.

Chapter 9 begins the second part with a comparison of planned and actual statements including profit center reports. Chapter 10 provides a discussion of responsibility accounting with considerable attention to evaluating the various marketing functions. Chapters 11 and 12 deal with manufacturing performance including variance analysis for material, labor, and overhead. Various types of overhead costs are examined in detail.

The last section is concerned with some basic concepts in accounting. Chapter 13 compares cash and accrual accounting. Chapter 14 provides a discussion of product costs and period costs and other timing issues such as the effects of different cost flow assumptions, depreciation, and the traditional inventory valuation methods. Chapter 15 is somewhat redundant, involving additional attention to traditional standard cost systems, flexible budgets, and variance analysis. The last chapter is labeled production methods and includes discussions of job order, continuous processing, and joint product costing.

Although the book has a commendable practice/experience flavor, it fails to deliver in several ways. First, the author's approach is almost entirely presentation by example, rather than the more traditional and comprehensible approach including algorithm, discussion, example. In general, there are very few algorithms, too many examples that are poorly spaced, and frequently, too little discussion. However, the book's major deficiency is the failure to include the newer concepts and cost management techniques such as activity based cost systems, just-in-time purchasing and production systems, flexible manufacturing systems, quality, and life cycle cost management. The book deals almost exclusively with the traditional topics of managerial accounting and finance. These are important topics, but they have been adequately addressed in dozens of books. Managers cannot afford to ignore the new cost management issues and are advised to look elsewhere for guidance.

JAMES R. MARTIN
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University of South Florida

ANNETTE E. MEYER, *Evolution of United States Budgeting: Changing Fiscal and Financial Concepts* (New York: Greenwood Press, 1989, pp. xiv, 179, $39.95).

The federal budget has become an increasingly controversial topic of interest to many groups. Citizens want to know where the money is going. Politicians want to influence budget allocations to enhance their political support. Economists want to understand the role of federal expenditures and deficits in the economy. Bureaucrats are interested because they are involved in preparing and administering budgets. Accordingly, budgeting can be appropriately studied from multiple perspectives including public administration, political science, accounting, and economics.

Unlike many other currently available books, this one is written from an economist's perspective. The tone is factual; the explanations are concise. It provides a comprehensive overview of the federal budget process from the inception of centralized budgeting in the 1920s to the present. The underlying focus is on the federal budget as an instrument to achieve such broad policy goals as full employment and price stability.

The casual reader who would like to know more about the federal budget process, including some of the terms often heard in the news, for example, sequestration, rescission, impoundment, or reconciliation, should probably start with the third through fifth chapters. This is the heart of the book and covers executive formulation of the budget, the role of Congress, and the execution and control phase. Throughout the book, a glossary would have been very helpful. However, the index is useful in reviewing any unclear concepts.

The major flaw of the book is its inattention to the political background of budget reforms. For example, the author only hints at the trouble between President Nixon and Congress in the early 1970s which was one factor that led to the 1974 budget reforms. Instead of overstatement, the book tends toward understatement. For example, political scientists talk about the sequestration provisions of the Gramm-Rudman-Hollings act of 1985 as "institutionalized terrorism," but this book merely says that the automatic spending cuts to meet deficit reduction targets "were not meant to be desirable" (p. 58). Accordingly, this is a book of facts and details uncolored by political rhetoric. It is a good reference for those who want a concise and clear explanation of the various budgetary reforms that have been implemented or proposed for the U.S. federal government.

The author's major recommendations for budget reform are well stated, and will make sense to most accountants. First, she recommends restructuring the system of budget authority so that authority and outlays against that authority can be related more easily. Second, she recommends improving the financial management and accounting systems government-wide. Finally, she would like to see the audit and review phase of the budget process reinstated. Surprisingly, there has been no review stage at all since FY1983. Furthermore, there has never been an overall review of the entire executed budget. The administration and Congress make all of their decisions based on estimates of future expenditures and revenues with no verified figures for comparison.

Since the book generally neglects the fascinating role of politics in federal budgeting, it probably has limited usefulness as a supplement to a governmental accounting or auditing course. There are other books better suited to capture student interest. However, academics, especially those with an economics background, will find this a useful reference for their personal or college libraries.

TERESA P. GORDON
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PACIFIC RESEARCH PUBLICATIONS, *Database Of Accounting Research Search Software*, Version 1.0 (Diamond Bar, CA, 1989, Disks 1–5, $60.00).

Pacific Research Publications has come up with a software tool that should prove indispensable to accounting researchers—a comprehensive database listing over 6,000 separate articles from 24 academic accounting journals for the 20-year period ending 12/31/88.

The impressive list of publications includes:

Abacus
Accounting, Auditing & Accountability
Accounting, Organisations and Society
Advances in Accounting
Advances in Public Interest Accounting
Contemporary Accounting Research
International Journal of Accounting Education and Research
Issues in Accounting Education
Journal of Accounting & Economics
Journal of Accounting Literature
Accounting and Business Research
Accounting Horizons
The Accounting Review
Advances in International Accounting
Auditing: A Journal of Practice & Theory
Georgia Journal of Accounting
Journal of Accounting, Auditing and Finance
Journal of Accounting Education
Journal of Accounting and Public Policy
Journal of Business, Finance & Accounting
Research in Accounting Regulation

Journal of Accounting Research	*Research in Governmental and Nonprofit Accounting*
The Journal of Information Systems	

A less than comprehensive list of excluded topical and applied accounting journals would include the *Journal of Accountancy*, *Computers in Accounting*, the *Journal of Accounting and Computers* (and its predecessor the *Kent/Bentley Review*), and *Management Accounting*. As the integration of computers and accounting is a relatively recent development, the exclusion of some of these periodicals is understandable. Hopefully, updates of this database will include some of them.

Each record lists, for each journal article, the title; the author(s); the (abbreviated) journal name; the year of publication; the page numbers; and the month, season, volume, and/or issue reference.

The software comes on five regular-density floppy disks. Implementation is simple—Disk No. 1 is placed in Drive A and, at the DOS prompt, the user types and enters: SEARCH. The time required for searching the entire database depends upon the hardware in use (see below). The user can print out each successful match by using the keyboard's Prt Sc key, or he or she can set the program to print all matches as they are found, automatically.

No serious software deficiencies were noted. The reviewer did get one unexpected display of hieroglyphics at one point, but it did not recur after terminating and reentering the program. Accurate input is encouraged since the search procedure cannot be interrupted—i.e., the user must wait until the database has been searched or a match has been found before he or she can either proceed with another query or terminate the program.

A brief trial revealed that record number 1067/1544 lists author as R. L. KENKE, while record number 1343/1544 lists an author as R. L. BENKE. Since the co-author is the same for both records, it can be assumed that one of these spellings is in error. This suggests that there may exist at least a few typographical input errors.

It is possible to enter all or any combination of seven variables to bring up a particular reference: (1) the author; (2) one, two, or three key words; (3) the journal name (i.e., acronym); (4) the month, or (5) the year. To find an author name, any sequence of letters can be effective. For example, RIE will match up with the name FRIEDMAN; RSM will bring up DIRSMITH; W.B. will bring up DAVIES, W. B.; D will bring up MCDOUGALL, and J. R. SMITH could be found by specifying SMITH, or J. R.

The strengths of this database lie in its retrieval capabilities, and in its focus on topics of interest to researchers in accounting. As compared to a conventional printed research index it is somewhat limited in its features. For example, it includes nothing comparable to the Citation Index developed by Brown, Gardner, and Vasarhelyi in their *Accounting Research Directory* (New York: Markus Wiener Publishing). On the other hand, the inclusion of 24 journals (vs. six for the latter publication) by far outweighs such a shortcoming. There is no classification technique for narrowing down one's search, but for a computerized database, this package's use of "keywords" is a preferable approach.

Not much is needed, nor is it provided, by way of instructions to simplify the utilization of this database. No computer expertise is required. All the user must do is to turn on the computer and bring up the DOS prompt, insert the first disk, and type: SEARCH. If he or she knows the author's name or at least one keyword, the user can bring up the reference he or she is looking for. Using (1) unique or extra keywords, (2) the journal acronym (e.g., the one for *Accounting Horizons* is AH), and/or (3) issue and year references will speed the search by minimizing irrelevant matches.

Extensive disk swapping, required with a floppy disk system, can be eliminated by installing the database on a hard disk. The higher speed of a 286 or 386 system will greatly reduce the time required for searching. For example, a standard two (5.25") drive personal computer (e.g., IBM's PC) system requires about 60 seconds per disk. It was observed that a complete search which would require five minutes plus disk swapping time in an XT micro environment, could be completed in only 30 seconds on a 286 16 MHz configuration.

For the modest investment required, no serious researcher with access to a PC can afford to be without this valuable retrieval tool. Hopefully the publishers will be encouraged to update the disks annually.

EDWARD M. CURRIE
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University of San Francisco

STANLEY C. W. SALVARY, *An Analytical Framework for Accounting Theory* (Fayetteville, AR: University of Arkansas, 1989, pp. xiv, 121, $10.00 paper).

The objective of this monograph is to develop a framework for financial accounting theory that is deliberately designed to be broader in scope and setting than the Financial Accounting Standards Board (FASB) conceptual framework document. Salvary uses the analytical tool of logical argument to present simultaneously the construction and proof of the framework. Chapter 1 includes a statement of the aforementioned objective of the treatise and provides justification for the method of presentation of the framework and related analyses.

In Chapters 2 and 3, Salvary describes accounting as an empirical science and suggests that the development of accounting theory requires a combination of the deductive, inductive, and intuitive approaches. He then provides examples from the current literature on which of these three approaches is the dominant research mode. Classifying efficient markets hypothesis (EMH) research within the intuitive category, Salvary proceeds to provide an extensive (nine and a half pages) critique of EMH research. In my opinion, the author spends too much time finding fault with this stream of research. He claims that its proponents have falsely assumed that "accounting information is a mere surrogate for security value and not a representation of some real world process" (p. 10). Admittedly, EMH researchers were overly enthused in the late sixties and early seventies about the ability of their research to provide insights into the desirability of alternative accounting principles. However, they always have assumed that accounting information is not the only source of information about the firm available to and used by capital market agents in setting securities prices. On the other hand, Salvary cites some studies from the economics literature concerning the existence of memory in securities prices that would be of interest to individuals engaged in capital markets research. Finally, Salvary's critique and discussion of the limitations of the studies using the deductive and inductive approaches are much more to the point and effective.

In Chapter 4, Salvary begins the presentation of his framework by making an interesting distinction between financial accounting and managerial accounting. He argues that when a decision maker is using financial accounting information to predict future events (loan default, bankruptcy, etc.), the decision maker is no longer within the realm of financial accounting, but rather within managerial accounting. I question the necessity of such a distinction. It blurs the traditional dichotomy of external versus internal (relative to the firm) decision makers, and it also calls into question the relationship between predictions and decisions, which justifies decision usefulness as a primary objective of financial accounting.

The subsequent chapters of the monograph (Chapters 5–7) present the specific details of Salvary's framework for accounting theory. The elements of the framework are split into two broad groups. Axioms, postulates, and precepts comprise the first group, while principles, concepts, rules, and methods comprise the second. These chapters are well done. They are internally consistent, well-written, and indicate the author's ability to access, understand, and incorporate relevant prior literature from accounting, economics, history, information theory, and the philosophy of science to support the framework. In addition, Salvary compares aspects of his framework with those of the FASB's conceptual framework and notes relevant similarities such as the analogy between accounting and cartography made both in his treatise and *Concepts Statement No. 2*. Chapter 8, the final chapter of the monograph, provides a brief conclusion and some suggestions for future research.

In spite of the shortcomings of some of the material in the earlier chapters, this monograph is a worthwhile contribution to the literature. It would be appropriate for use as supplemental material either in a master's-level financial accounting theory course or a graduate seminar in the history of accounting thought.

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RAJENDRA P. SRIVASTAVA and JAMES E. REBELE, Editors, *Auditing Symposium IX: Proceedings of the 1988 Touche Ross/University of Kansas Symposium on Auditing Problems* (Lawrence, KS: University of Kansas, 1988, pp. viii, 146, $10.00 paper).

This publication is the collection of papers and comments presented at the ninth symposium in the biennial series held at the University of Kansas and sponsored by Touche Ross & Co. The overall purpose of this symposium, and the preceding eight, was to bring together practitioners and academics to discuss current problems and issues in auditing. The book contains the eight papers and seven discussants' comments formally presented at the symposium.

As in the past, the format of the symposium paired a practitioner and an academic on an issue. Half of the papers were presented by academics and half by practitioners. The discussant of an academic paper was always a practitioner, and vice versa. Accordingly, the resultant "book" cannot be considered either an academic or a practice-oriented work. However, this unique format has again provided a fruitful combination of the two often disparate points of view.

Although each of the papers cannot be addressed separately, the following is a list of the issues discussed: (1) use of audit decision aids, (2) audit theory paradigms, (3) changes in standards for assessing internal control, (4) development of a specific knowledge-based decision aid, (5) standards governing written and oral reports on the application of accounting principles, (6) auditor evidential planning judgments, (7) whether auditing is still the profession's "profit center," and (8) accounting standards and professional ethics.

As with any collection of papers, some are more insightful than others. The paper by Robert H. Ashton and John J. Willingham entitled "Using and Evaluating Audit Decision Aids" and the paper by Arnold Wright and Theodore J. Mock entitled "Auditor Evidential Planning Judgments" (the only empirical research paper) and the discussant responses by Stephen J. Aldersley and Robert H. Temkin, respectively, are of particular merit. Both of these papers address the general issue of auditor judgment. The former paper contains a useful discussion of the development and use of decision aids in auditing. The authors and discussant provide a useful overview of the strengths and shortcomings of using decision aids. Aldersley's remarks also point out the beneficial aspects of using decision aids as training tools in today's complex audit environment. The Wright and Mock paper summarizes some of the judgment literature and assesses auditor judgment regarding broad evidence gathering procedures. The paper and discussant's remarks provide useful insight into the consistency/inconsistency and consensus/lack of consensus in evaluating audit procedures used in practice. The remarks of Temkin are very insightful and provide a practical interpretation of the judgment study and the results, as well as the phenomenon of "audit judgment" itself and the nature of the judgment process in auditing. These papers illustrate well the need for further research in the judgment area.

Also, the paper by Jerry D. Sullivan entitled "Why the Auditing Standards on Evaluating Internal Control Needed to be Replaced" and the fervent response by William R. Kinney, Jr., that presents an opposite view, provide well-articulated positions that will undoubtedly foster continued debate.

In general, the practitioner responses to the academic papers are beneficial not only in providing a different perspective on the issue, but also for pointing out the respective paper's shortcomings in both theory and practical application (particularly John B. Sullivan's discussion of "Auditor's Assistant: A Knowledge-based Engineering Tool"). The academic responses to the practitioner papers are also typically beneficial in noting relevant points from a different perspective.

The only flagrant shortcoming of any of the 15 pieces was the response to Jack C. Robertson's paper entitled "Audit Theory Paradigms." The paper discusses the question of whether or not auditing currently has a cohesive paradigm and evaluates several potential theories. The use of a nonacademic discussant on this paper just did not work. The paper was written primarily for academics familiar with discussions of paradigms, positive and normative theory, theory closure, etc., and was not easily amenable to critical analysis by a nonacademic. This is not a criticism of practitioners, but an instance where the topics addressed was not easily approachable from a nonacademic perspective.

All of the papers except one by Arthur R. Wyatt, on the tendency of accountants to circumvent promulgated accounting standards, were accompanied by a discussant's remarks. The book does not indicate why no discussant was provided for the Wyatt paper. An additional viewpoint on this issue would seem appropriate and more consistent with the rest of the book.

In general, the articles and discussants' remarks contribute to the objective of the symposium. I believe that auditing practitioners and academics will generally find the combination of issues and perspectives of the participants stimulating reading. Most of the papers are clearly written and would also be useful for undergraduate classroom discussions. The paper by Robertson would be well suited for use in a Ph.D. seminar. In sum, the collection of papers provides a beneficial overview of both practitioner and academic positions on some of the current issues facing the profession.

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BOOKS RECEIVED NOVEMBER 9, 1989 TO FEBRUARY 5, 1990

PETER W. BERENSTEIN, Editor, *Ernst & Young's Arthur Young Tax Guide 1990* (New York: Ballantine Books, 1989, pp. xxvi, 687, $11.95 paper).

ERIK BIORN, *Taxation, Technology, and the User Cost of Capital* (Amsterdam: North-Holland, 1989, pp. xii, 325, U.S. $65.00/DFL. 175.00).

J. L. G. BOARD, J. F. S. DAY, and M. WALKER, *The Information Content of Unexpected Accounting Income, Funds Flow and Cash Flow* (London, U.K.: Institute of Chartered Accountants in England and Wales, 1989, pp. 17, £10.00 paper).

MARTIN CALPIN, *Understanding Audits and Audit Reports*, Fifth Edition (Toronto: The Canadian Institute of Chartered Accountants, 1989, pp. vii, 46, $10.00 paper).

THE CANADIAN INSTITUTE OF CHARTERED ACCOUNTANTS, *Financial Reporting in Canada*, Eighth Edition (Toronto: The Canadian Institute of Chartered Accountants, 1989, pp. 263, $32.50, paper).

SIR BRYAN CARSBERG and CHRISTOPHER NOKE, *The Reporting of Profits and the Concept of Realisation* (London, U.K.: The Institute of Chartered Accountants in England and Wales, 1989, pp. 71, £10.00 paper).

TOM COPELAND, TIM KOLLER, and JACK MURRIN, *Valuation: Measuring and Managing the Value of Companies* (New York: John Wiley & Sons, 1990, pp. xviii, 428, $60.00).

JOHN P. FERTAKIS, *The Design and Implementation of Administrative Controls: A Guide for Financial Executives* (New York: Quorum Books, 1989, pp. xvi, 184, $45.00).

G. MACDONALD and B. A. RUTHERFORD, Editors, *Accounts, Accounting and Accountability* (London: Van Nostrand Reinhold Co., 1989, pp. xii, 221, £25.00).

M. J. PAGE, B. E. ELLIOTT, and N. S. BRISTOW, *Staffing and the Smaller Firm* (London, U.K.: Institute of Chartered Accountants in England and Wales, 1989, pp. 88, £10.00 paper).

GARY JOHN PREVITS, Editor, *Research in Accounting Regulation*, Volume 3 (Greenwich, CT: JAI Press, 1989, pp. xv, 249, $63.50 (institutions), $38.10 (individuals).

EMMANUEL N. ROUSSAKIS, *Commercial Banking in an Era of Deregulation*, Second Edition (New York: Praeger Publishers, 1989, pp. xv, 428, $55.00).

WILLIAM V. RUCH, *International Handbook of Corporate Communication* (Jefferson, NC: McFarland & Company, 1989, pp. x, 486, $49.95).

SHANGHAI UNIVERSITY OF FINANCE AND ECONOMICS and CENTER FOR INTERNATIONAL ACCOUNTING DEVELOPMENT, The University of Texas, *Accounting and Auditing in the Peoples Republic of China: An Addendum* (Richardson, TX: The University of Texas at Dallas, 1989, pp. iv, 28, $5.00 paper).

G. A. SWANSON and JAMES GRIER MILLER, *Measurement and Interpretation in Accounting: A Living Systems Theory Approach* (New York: Quorum Books, 1989, pp. xvi, 219, $45.00).

JANET M. SYDLASKE and RICHARD K. MILLCROFT, *The Only Tax Audit Guide You'll Ever Need* (New York: John Wiley & Sons, 1990, pp. x, 326, $12.95 paper).

PETER W. WOLNIZER, *Auditing As Independent Authentication* (Sydney University Press, 1987, pp. xvi, 219, $45.00).

MANUSCRIPT PREPARATION AND STYLE

The Accounting Review's manuscript preparation guidelines follows (with a slight modification) the B-format of the *Chicago Manual of Style* (13th ed.; University of Chicago Press). Another helpful guide to usage and style is *The Elements of Style*, by William Strunk, Jr., and E. B. White (Macmillan). Spelling follows *Webster's International Dictionary*.

FORMAT

1. All manuscripts should be typed on one side of 8½ × 11" good quality paper and be double spaced, except for indented quotations.
2. Manuscripts should be as concise as the subject and research method permit, generally not to exceed 7,000 words.
3. Margins of at least one inch from top, bottom, and sides should facilitate editing and duplication.
4. To assure anonymous review, authors should not identify themselves directly or indirectly in their papers. Single authors should not use the editorial "we."
5. A cover page should show the title of the paper, the author's name, title, and affiliation, any acknowledgements, and a footnote indicating whether the author would be willing to share the data (see last paragraph in this statement).

Pagination: *All* pages, including tables, appendices, and references, should be serially numbered. The first section of the paper should be untitled and unnumbered. Major sections may be numbered in roman numerals. Subsections should not be numbered.

Numbers: Spell out numbers from one to ten, except when used in tables and lists, and when used with mathematical, statistical, scientific, or technical units and quantities, such as distances, weights, and measures. For example: *three days; 3 kilometers; 30 years*. All other numbers are expressed numerically. Generally when using approximate terms spell out the number, for example, *approximately thirty years*.

Percentages and Decimal Fractions: In nontechnical copy use the word *percent* in the text; in technical copy the symbol % is used. (See the *Chicago Manual* for discussion of these usages.)

Hyphens: Use a hyphen to join unit modifiers or to clarify usage. For example: a *well-presented analysis; re-form*. See *Webster's* for correct usage.

Key Words: The synopsis is to be followed by four *key words* that will assist in indexing the paper.

SYNOPSIS

A synopsis of about 400 words should be presented on a separate page immediately preceding the text. The synopsis should be nonmathematical and include a readable summary of the research question, method, and the significance of the findings and contribution. The style should be objective, without personal pronouns. The title, but not the author's name or other identification designations, should appear on the synopsis page and on the first page of the text.

TABLES AND FIGURES

The author should note the following general requirements:

1. Each table and figure (graphic) should appear on a separate page and should be placed at the end of the text. Each should bear an arabic number and a complete title indicating the exact contents of the table or figure.
2. A reference to each graphic should be made in the text.
3. The author should indicate by marginal notation where each graphic should be inserted in the text.
4. Graphics should be reasonably interpreted without reference to the text.
5. Source lines and notes should be included as necessary.

Equations: Equations should be numbered in parentheses flush with the right-hand margin.

DOCUMENTATION

Citations: Work cited should use the "author-date system" keyed to a list of works in the reference list (see below). Authors should make an effort to include the relevant page numbers in the cited works.

1. In the text, works are cited as follows: authors' last name and date, without comma, in parenthesis: for example, (Jones 1987); with two authors: (Jones and Freeman 1973); with more than two: (Jones et al. 1985); with more than one source cited together (Jones 1987; Freeman 1986); with two or more works by one author: (Jones 1985, 1987).
2. Unless confusion would result, do not use "p." or "pp." before page numbers: for example, (Jones 1987, 115).
3. When the reference list contains more than one work of an author, the suffix *a*, *b*, etc. follows the date in the text citation: for example, (Jones 1987a) or (Jones 1987a; Freeman 1985b).

4. If author's name is mentioned in the text, it needs not be repeated in the citation; for example, "Jones (1987, 115) says. . . ."
5. Citations to institutional works should use acronyms or short titles where practicable; for example, (AAA ASOBAT 1966); (AICPA Cohen Commission Report 1977). Where brief, the full title of an institutional work might be shown in a citation: for example, (ICAEW *The Corporate Report* 1975).
6. If the manuscript refers to statutes, legal treatises, or court cases, citations acceptable in law reviews should be used.

Reference List: Every manuscript must include a list of references containing only those works cited. Each entry should contain all data necessary for unambiguous identification. With the author-date system, use the following format recommended by the *Chicago Manual*:

1. Arrange citations in alphabetical order according to surname of the first author or the name of the institution responsible for the citation.
2. Use author's initials instead of proper names.
3. Dates of publication should be placed immediately after author's name.
4. Titles of journals should not be abbreviated.
5. Multiple works by the same author(s) should be listed in chronological order of publication. Two or more works by the same author(s) in the same year are distinguished by letters after the date.
6. Inclusive page numbers are treated as recommended in *Chicago Manual* section 8.67.

Sample entries are as follows:

American Accounting Association, Committee on Concepts and Standards for External Financial Reports. 1977. *Statement on Accounting Theory and Theory Acceptance*. Sarasota, FL: AAA.

Fabozzi, F., and I. Pollack, eds. 1987. *The Handbook of Fixed Income Securities*. 2d ed. Homewood, IL: Dow Jones-Irwin.

Demski, J. S., and D. E. M. Sappington. 1989. Hierarchical structure and responsibility accounting. *Journal of Accounting Research* 27: 40–58.

Dye, R., B. Balachandran, and R. Magee. 1989. Contingent fees for audit firms. Working paper, Northwestern University, Evanston, IL.

Kahneman, D., P. Slovic, and A. Tversky, eds. 1982. *Judgment Under Uncertainty: Heuristics and Biases*. Cambridge, United Kingdom: Cambridge University Press.

Porcano, T. M. 1984a. Distributive justice and tax policy. *The Accounting Review* 59 (October): 619–36.

———. 1984b. The perceived effects of tax policy on corporate investment intentions. *The Journal of the American Taxation Association* (Fall): 7–19.

Shaw, W. H. 1985. Empirical evidence on the market impact of the safe harbor leasing law. Ph.D. dissertation, University of Texas, Austin.

Sherman, T. M., ed. 1984. *Conceptual Framework for Financial Accounting*. Cambridge, MA: Harvard Business School.

Footnotes: Footnotes are not used for documentation. Textual footnotes should be used only for extensions and useful excursions of information that if included in the body of the text might disrupt its continuity. Footnotes should be double spaced and numbered consecutively throughout the manuscript with superscript Arabic numerals. Footnotes are placed at the end of the text.

SUBMISSION OF MANUSCRIPTS

Authors should note the following guidelines for submitting manuscripts:

1. Manuscripts currently under consideration by another journal or other publisher should not be submitted.
2. In the case of manuscripts reporting on field surveys or experiments, four copies of the instrument (questionnaire, case, interview plan, or the like) should be submitted.
3. Four copies should be submitted together with a check for $50.00 in U.S. funds made payable to the American Accounting Association. Effective January 1990, the submission fee is nonrefundable.
4. The author should retain a copy of the paper.
5. Revisions must be submitted within 12 months from request, otherwise they will be considered new submissions.

COMMENTS

Comments on articles previously published in *The Accounting Review* will be reviewed (anonymously) by two reviewers in sequence. The first reviewer will be the author of the original article being subjected to critique. If substance permits, a suitably revised comment will be sent to a second reviewer to determine its publishability in *The Accounting Review*. If a comment is accepted for publication, the original author will be invited to reply. All other editorial requirements, as enumerated above, also apply to proposed comments.

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POLICY ON DATA AVAILABILITY

The following policy has been adopted by the Executive Committee in its April 1989 meeting.

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where Se_{it} = standardized residual for firm i in week t and e_{it} = residual for firm i in week t.

The standardized cumulative residual, SCR_{it}, over any interval $t = T_{1i}, \ldots, T_{2i}$ is:

$$SCR_{it} = \sum_{t=T_{1i}}^{T_{2i}} (Se_{it}/\sqrt{T_{2i} - T_{1i} + 1}). \tag{5}$$

The test statistic for a sample of M firms is:

$$Z_t = \sum_{i=1}^{M} SCR_{it}/\sqrt{M}. \tag{6}$$

Because each Se_{it} is assumed to be distributed unit normal in the absence of abnormal performance, Z is assumed unit normal.[5] A two-sample t-test utilizing the SCR for each sample is used to test for a difference in CARs between the purchase and pooling firms.

III. Tests of Hypotheses

Table 2 provides a summary of the CARs during various intervals. As reported in panel A, a statistically insignificant CAR of 7.33 percent is observed for the full sample over the entire test period. In the period prior to the announcement date, however, significant CARs of 5.28 percent and 2.71 percent are noted in the −26 through ANN and −11 through ANN week periods, respectively. No significant residuals are noted in the week of the announcement. These results are similar to Dodd (1980) and Eckbo (1983), and they provide evidence for rejecting hypothesis H1.

Evidence on hypothesis H2 is reported in panel B of table 2. Also, figure 1 presents a plot of the CARs for both groups over the test period.[6] As in Hong et al., differential abnormal returns are observed. CARs for firms using the pooling method are frequently positive but never statistically significant. In contrast, the purchase method CARs are both positive and statistically significant throughout the entire test period, although, as

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[4] The value of s_{it} is given by:

$$s_{it} = \left[s_i^2\left(1 + \frac{1}{D_i} + (R_{mt} - \bar{R}_m)^2 \Big/ \sum_{v=1}^{D_i} (R_{mv} - \bar{R}_m)^2\right)\right]^{1/2},$$

where:

s_i^2 = residual variance for firm i from the market model regression;
D_i = number of observations during the estimation period for firm i;
R_{mt} = rate of return on the market index during week t of the observation period;
$\bar{R}_m$ = mean rate of return on the market index during the estimation period; and
R_{mv} = rate of return on the market index during week v of the estimation period.

[5] It is possible that the mean cumulative residual and the mean standardized cumulative residual could be of different sign if there are a few extreme negative outliers. These instances occurred infrequently in this study, but they did result in opposite signs in several statistically insignificant intervals in table 2.

[6] As the interim period between the announcement and merger effective dates varies from firm to firm, it is collapsed into a single measurement period.

Table 2

Summary of CARs (Percentage) Over Various Intervals

Panel A. All Firms:

Interval (Weeks)[1]	*CAR*	*Test Statistic*
ANN−26 through EFF+26	7.33	1.37
−26 through ANN	5.28	2.18[b]
−11 through ANN	2.71	1.98[b]
−4 through ANN	1.75	1.61
ANN week	−0.06	−1.01
Interim	1.99	0.49
EFF week	−0.25	−0.95
EFF+1 through EFF+26	0.30	−0.20

Panel B. Disaggregated Samples:

	Purchase Firms		*Pooling Firms*		
Interval (Weeks)[1]	*CAR*	*Test Statistic*	*CAR*	*Test Statistic*	*Test Statistic on Difference*
ANN−26 through EFF+26	13.56	2.70[a]	3.34	−0.41	2.37[b]
−26 through ANN	9.07	2.80[a]	2.85	0.56	1.84[c]
−11 through ANN	4.58	2.46[b]	1.51	0.57	1.56
−4 through ANN	3.03	2.19[b]	0.94	0.31	1.52
ANN week	−0.06	−0.37	−0.05	−1.00	0.33
Interim	2.42	1.27	1.72	−0.40	1.24
EFF week	−0.15	−0.35	−0.31	−0.94	0.32
EFF+1 through EFF+26	2.22	0.62	−0.92	−0.76	0.96

[1] ANN=Announcement week per *The Wall Street Journal*; EFF=Effective week. Numbers are weeks relative to the announcement or effective week.

[a] Significant at .01.

[b] Significant at .05.

[c] Significant at .10.

expected, most of the reaction appears to occur in the 26 weeks prior to the announcement.[7]

IV. Investigation into Potential Explanations

Nonmerger-Related CAPM-Omitted Variables

Numerous studies have examined the impact of the following omitted variables in the simple one-period capital asset pricing model (CAPM): P/E ratio (Basu 1977, 1983), firm size (Banz 1981; Reinganum 1981), earnings surprise (Beaver et al. 1979; Hagerman et al. 1984), leverage (Bernard 1986), and market model parameter estimates (Blume 1971, 1975, 1979; Elgers et al. 1979). In this study, I examine whether the

---

[7] Examination of the weekly ARs indicated that, while none was significant for the pooling method firms, eight of the purchase method ARs were significant ($p \leq 0.05$). Five of the eight occurred in the 26-week period prior to the announcement date, with three of these coming in weeks −11, −9, and −4. The AR in week −11 was the largest (2.4 percent, test statistic=3.88), and this group of three ARs appears to be responsible for the CARs remaining significant throughout the remaining test period. This finding is similar to Hong et al.

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